SCIENCE

FRIDAY, DECEMBER 31, 1915

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE FRUITS, PROSPECTS AND LESSONS OF RECENT BIOLOGICAL SCIENCE[1]

THE general welfare of mankind has been wonderfully promoted during the past 150 years by the rapid progress of chemical, physical, and biological science. In the early third of that period, physics and chemistry and their applications seem to have played the most active parts in promoting human welfare, although pure botany and zoology enlisted many devoted workers, and made great advances; but during the past 100 years it is biological science that has contributed most to the well-being of humanity. The new methods of transportation and of manufacturing by the aid of machinery with steam as motive power were products of applied physics. So were the great works of civil and mechanical engineering. The improved agriculture of the last half of the nineteenth century was partly due to new tools and machinery, and partly to new applications of chemical knowledge. Latterly biological science has helped the farmer very much to raise better crops and animals, and to protect his products from vegetable and animal pests.

While the industrial and social changes, which applied physics and chemistry made possible, unquestionably improved the general condition of mankind as regards bodily comfort, security against natural catastrophes, longevity, and an increased sense of mutual support and community interest through the vast improvement in the means of communication, these changes

[1] Address of the retiring president of the American Association for the Advancement of Science, given at the Columbus meeting, December 27, 1915.

have all been *indirect* influences on human well-being and happiness, and with the good they brought much evil was mixed. Thus, the factory system, the congestion of population, and the noise and turmoil of city life are grave evils accompanying the advantages which applied physics and chemistry have created and diffused. The fruits of the biological sciences—botany, zoology, physiology and biochemistry, applied to curative medicine and surgery and to preventive medicine and sanitation—have been *direct* contributions to human welfare; because they have provided defenses against disease, premature death, and individual and family distress and suffering. The beneficent applications of biological science, unlike most of the large results of applied chemistry and physics, take effect in the field of human affections and family experiences, make life less anxious and more enjoyable for multitudes of human beings, mitigate or abolish ancient agonies and dreads of the race, and promise for it a happier future.

The career of Pasteur illustrates admirably the passing of the center of beneficent scientific research from chemistry and physics to biological science. Pasteur's first researches were crystallographic; whence he passed to the study of molecular dissymmetry, the material of his researches being, however, organic. He was first professor of physics and then professor of chemistry. His interest in certain tartrates led him naturally, though partly by accident, to a study of fermentation. His zealous discharge of his duties as Dean of a Faculty of Sciences at Lille, a manufacturing center, led to his study of beet-root juice, fermented in order to produce alcohol. Thereafter Pasteur's researches were biological, although he had had no training as either naturalist or physician. He began at the foundation by disproving the doctrine of spontaneous generation. One of his earliest conclusions was that "gases, fluids, electricity, magnetism, ozone, things known or things occult, there is nothing in the air that is conditional to life except the germs it carries." Of his earliest results from experiments on admitting pure air to flasks containing putrescible infusions he wrote:

> It seems to me that it can be affirmed that the dusts suspended in atmospheric air are the exclusive origin, the necessary condition of life in infusions;

and in the same paper he made the pregnant remark:

> What would be most desirable would be to push those studies far enough to prepare the road for serious research into the region of various diseases.

He lived to push his studies into the causes of the silk-worm disease, of a cholera which came from Egypt into France, of the plant diseases affecting the manufacture of wine and of beer, of the splenic fever, of the chicken-cholera, and of rabies; and he and his followers invented successful treatment for those diseases, and for the treatment of typhoid fever and diphtheria. The germ and parasite theory of disease led the way in serum therapy, and established both the philosophy and the practise of the new medicine and surgery of the past thirty-five years. Starting with a sound knowledge of chemistry and physics, and having early acquired a habit of utmost accuracy in observing and reasoning, Pasteur passed over into biological science by the time he was thirty-two years of age, and became the most suggestive and productive inventor and promoter in applied biology that has ever lived. His career illustrates conspicuously the general truth that the sciences most serviceable to mankind during the past sixty years have been the biological sciences. In a letter to his father in

1860, when his inquiries were opening new vistas in physiology, Pasteur wrote:

> God grant that by my persevering labors I may bring a little stone to the frail and ill-assured edifice of our knowledge of those deep mysteries of life and death, where all our intellects have so lamentably failed.

That prayer was granted.

Let us review in a summary way the fruits of applied biological science since the nineteenth century opened.

The first invention, vaccination against smallpox, long antedated the later studies of germs, parasites, the routes of disease from one human being to another through insects and other animals, and the theory and practise of immunity. Vaccination, the invention of a country doctor who practised in a dairy district, was a momentous discovery in immunity from a fatal and disfiguring disease which was frequently epidemic, the immunity being procured by causing in the human body another disease very seldom fatal and not at all disfiguring. The favorable reception and rapid application of Jenner's discovery were due to the fact that many persons at that time protected themselves against the frequent and terrible epidemics of smallpox by being inoculated with smallpox itself. So soon as it was proved that cowpox gave immunity in almost all cases against smallpox, inoculation with cowpox came rapidly into use; because inoculated cowpox proved to be, as one of Jenner's contemporaries remarked, "a pleasanter, shorter, and infinitely more safe disease than inoculated smallpox." The relief of civilized mankind from the terrible recurrent epidemics of smallpox is one of the greatest benefits that the profession of medicine has conferred on the human race.

From biological studies largely on microscopic organisms—protozoa, bacteria, and parasitic growths—the means of communication from one human being to another or from an animal to man of dysentery, cholera, typhoid fever, typhus fever, puerperal fever, bubonic plague, diphtheria, tuberculosis, cerebro-spinal meningitis, syphilis, gonorrhoea, sleeping sickness, yellow fever, malaria, and hookworm disease have all been brought to light. Means of preventing or restricting the spread of these diseases—with the exception of cerebro-spinal meningitis—have been invented, and for most of them improved methods of treatment have been devised. Much has also been learnt about infantile paralysis, and something about cancer. The whole subject of toxins and anti-toxins has been developed with wonderfully beneficent results.

It is really impossible to describe or appreciate the alleviations and preventions of human misery included in this list of the fruits of applied biological science. Some of the diseases mentioned were within a few years familiar household terrors in the most civilized countries, others from time to time destroyed in recurring epidemics large portions of the population in many parts of the world. They terrorized families and nations, made innumerable homes desolate, and ruined for a time cities and states. The generations now on the stage can hardly appreciate the formidable apprehensions from which their predecessors suffered, but they themselves have been relieved by the achievements of medical research and preventive medicine. This blessed preventive medicine may almost be said to have been created by the combination of bacteriological and pathological studies, which are all, of course, biological studies. Physiology has been wonderfully developed as a study of biological processes by the addition of bacteriological experimentation to

its former chemical and physical methods of research.

Public health boards have been established and equipped to perform under new laws numerous functions which had no existence until applied biology with aid from chemistry and physics indicated the desirable modes of public action. The boards, or public health commissioners, prescribe, teach and enforce rules and orders concerning personal, industrial, farm and dairy, and school hygiene, social hygiene including venereal prophylaxis for individuals and families, the preservation of foods and their protection from infection, the effects of various industries on the health of employees, the connection of syphilis with insanity and general paresis, and of gonorrhea with blindness, procure vital statistics, establish registration of births and deaths, and of cases of disease, study epidemics and infant mortality, and contend against dangerous contagious diseases by quarantines, isolation, disinfection, and the destruction of the insect and vermin carriers of disease. All these activities have been completely dependent on applied biology for their methods and processes, and have changed and developed rapidly with the progress of that science. Taken together they constitute an immense contribution to human welfare, present and future.

It is animal experimentation with the help of anesthesia and asepticism which has given mankind by far the larger part of all the exact knowledge of medicine now possessed, and promises still greater serviceableness in the future. In the service of man new studies have been made, not only of microscopic plants and animals, but of many larger creatures which live with man, such as poultry, rabbits, guinea pigs, cats, dogs, cattle, horses, mules and monkeys, and of many insects, such as flies, ticks, mosquitoes, and lice which infest the fauna and flora which surround man, or the bodies or clothes of men themselves. An immense mass of biological information on all these subjects has been accumulating during the past two generations, and is growing rapidly from year to year, as the good results of such studies become better known.

These results bear directly on the well-being and happiness of the human race, but also indirectly on the economic and commercial fortunes of the race. Through the well-directed efforts of the Rockefeller Sanitary Commission hundreds of thousands of persons in the Southern States of this country have, within the last five years, been made much more effective laborers, because relieved of the hookworm disease; and this good work is now being extended by the International Health Commission—one of the departments of the Rockefeller Foundation—to the West Indies, Central America, Ceylon, and the Straits Settlements. The work of this Commission has three divisions: (1) the Commission makes surveys of regions where hookworm disease is prevalent; (2) then it cures multitudes of sufferers by active and persistent treatment; and (3) it teaches people by the thousand how to prevent the recurrence of the disease in farming communities by using privies and wearing shoes. In the last two processes it tries—often successfully—to enlist existing public authorities and the taxing power in the work, in order to give it permanence. All this beneficent action is fruit of biological research. It would have been impossible to dig the Panama Canal, without the effective control over yellow fever and malaria which biological science has given to the race within a single generation. Two humane contributions to military efficiency during the Great War

are results of biological research applied to sanitation, one the prevention of epidemics of fever and cholera in the camps and trenches in Western Europe, and the other the quick arrest of a terrible epidemic of typhus fever in Serbia.

Let us next take account of the prospects of applied biology in the coming years. May we anticipate for it an increasing or a decreasing influence?

The progress of medical and surgical research during the past twenty years is of great promise for the future. It goes on actively in every good medical school, in many hospitals and dispensaries, and in the new institutes exclusively devoted to research. It is strongly supported by the new tendency to maintain in medical schools professorships of comparative anatomy, physiology and pathology. The importance of comparative pathology is just coming to be recognized. Inasmuch as animal experimentation, with the help of anesthesia and asepticism, is nowadays the principal means of extending the knowledge of the causes of disease and of the means of remedy and prevention, the importance of comparative studies on many species of animals, including man, has become obvious to all persons who think about the improvement of the human race and of its useful animal associates.

In regard to the treatment of contagious diseases, the story of the recent past can not but suggest hopes of even more rapid progress in the future towards the effective control of some of the worst diseases that afflict humanity. Thus, in the ten years from 1903 to 1913 syphilis was transmitted artificially to certain lower animals; the characteristic bacillus of that disease was discovered; the Wasserman test was invented, a test which enables an expert in its use to detect those cases which have no external symptoms; the value of salvarsan, as a safe destroyer of the bacillus within the human body, was demonstrated; and the bacillus was grown in pure culture outside of the body, whence resulted luetin, an important aid in the diagnosis of obscure cases; and finally the bacillus was detected in the brain of patients suffering from general paresis, and in the spinal cord of patients with locomotor ataxia. This series of discoveries and inventions has given to man a much improved control over this terrible scourge; but this control is not yet applied on an adequate scale. It remains for the future to cause this destructive disease to be early recognized, reported, and effectively dealt with. It is for state and municipal boards of health to invent and put into practise the means of contending against the spread of this horrible disease. This is a public health problem of the gravest sort. That public health authorities may succeed in the future against the horribly destructive effects of syphilis on every civilized race in the world is one of the hopes of the future, a hope inspired by the recent progress of biological science.

The progress of bio-chemistry and bacteriology has already enabled civilized governments to do much for the protection of their people from injury by foods not fit for consumption and by adulterated drugs. This is a branch of the public health service which is capable of large extension hereafter. The efficiency of the methods now used will be greatly increased; and they will be used in new fields. It is more than forty years since the Massachusetts Board of Health gave effective attention to the transportation and slaughtering of animals intended for food, an admirable piece of pioneering which brought about great improvements,

and served as a basis for further measures of defense for the community. The common use of cold-storage for meats, vegetables and fruits has lately increased the need of protection against damaged foods; and this cold-storage process is likely to be more and more used in the future—quite legitimately—for the preservation of perishable foods produced in greater quantity than can be sold at or near the time of their production. A cold-storage plant performs as to foods the function of the reservoir in an irrigation plant. Both urban and rural communities have much to hope in the future from cold-storage and irrigation; but to both these public utilities applied biological science must contribute indispensable precautions. There are climates in which extensive irrigation is liable to produce and perpetuate pestiferous insects.

One of the most favorable results of applied biology during the past fifty years is the great addition made to the means of detecting the true causes of abnormal conditions of the human body, and to the accuracy of diagnostic reasoning on both acute and chronic disorders. These new means of diagnosis and examination are in part chemical and physical, but chiefly biological. The theory and practise of asepsis are results of biological researches. Comparative anatomy, physiology and pathology all contribute largely to modern sanitation and to all the practises of boards of health for the discovery and prevention of unsanitary conditions in both urban and rural communities. Very promising examples of these useful practises are: the precautions nowadays taken against contagious disease in schools, the employment of school nurses, the inspection of school children's teeth, eyes, noses, ears and skin, the discovery in the mass of school children of the defective, the feeble-minded, and of those suffering from glandular abnormalities, particularly in the nose, mouth, and throat. The effective treatment of school children following on the detection of their disorders or defects promises much toward the better health of the coming generations. The successful use of the Schick test which enables the physician through a laboratory expert to separate the susceptible from the non-susceptible individuals who have been exposed to diphtheria, and therefore to avoid all unnecessary administrations of antitoxin, seems to open a wide prospect in the study of natural immunity. The process of improvement is not going to stop; on the contrary it will advance at an accelerated pace.

Another great field for applied biological science in the future is the contest against alcoholism and sexual vice. This is an important part of the province of social hygiene, a province which includes the philanthropic and economic treatment of the feeble-minded, the insane, the paralyzed, and the blind. The field is enormous; and its evils are intimately connected one with another; but in the whole field the means of cure and prevention have come in the main from biological research. There is every reason to expect that this great field for Christian effort will hereafter be more effectually cultivated than it has ever been.

In connection with the medical, surgical, and sanitary activities of the present day, new forms of educational effort have been instituted which are very promising for the future health and comfort of mankind. Thus, the institution of district nursing has already developed strong educational effects. The district nurse goes from house to house to treat and comfort individual patients suffering from various disorders; but in every house she also teaches the mother, sister, or some other attendant on

the sick or injured person, how to perform herself the remedial operations, how to feed the patient, and how to prevent the communication of the disease to other persons; and this teaching function of the nurse is quite as important as her curative or comforting ministrations. The social worker who follows up the out-patients of a great hospital, sees them at their homes, studies their surroundings, and gives them sympathetic counsel, has a similar teaching function, which often takes strong effect on whole families and even larger groups. Like the district nurse, she also frequently obtains family histories which are of value to students of inheritance, good or bad, and of eugenics. The same is true of the school nurse and medical inspectors who are employed by American cities in which the health department is strong and well-organized. These nurses and doctors not only detect defects and diseases in school children, but indicate to parents or friends the remedial measures that are demanded, and give much instruction to parents and guardians about keeping children well. The same educational function is performed by the dentists who are being employed in a few American cities to make periodical inspections of the teeth of school children. These large-scale examinations and teachings call for knowledge of bacteriological information and methods only recently acquired, and for skill in the use of diagnostic tools and appliances only recently invented. These new applications of biological science promise great reduction of human suffering and distress, and significant additions to average longevity and average efficiency, so soon as they come into general use.

Biological science has made possible several other kinds of widespread teaching which are certain to have beneficial effects on the productiveness of human labor, particularly in agriculture, the fundamental industry. Thus, the whole work of the International Health Commission is essentially educational. It teaches the people in hookworm disease districts by demonstration, first, that they have the disease; secondly, that it can be cured in the individual and eradicated from the community; and thirdly, that the embryos of the disease live by thousands in soil that has been befouled by an infected person, and are there ready to infect any person with whose bare, soft skin they come into contact. These demonstrations combined teach the people how the disease may be avoided in the future by an individual or by a community. As a result of this educational work, the common people and the health authorities cooperate effectively in both the work of treatment and that of prevention.

Another illustration of the broad educational processes now at work in consequence of the achievements of applied biology is to be found in the short courses given by many state universities to farmers and their grown-up sons on the principles of agriculture, the choice of seeds, and stock-raising, and in the itinerant teaching for adults now carried on by the U. S. Department of Agriculture throughout the Southern States on similar subjects. This instruction is supplemented by the offer of prizes, and the setting-up of model farms, or model acres, in great number as lessons and incitements to neighborhoods. The effects on the productiveness of American agriculture, especially in cotton and corn, are already remarkable; but the promise of these educational methods for the future is more precious still. Several colleges and universities of high standing now provide short courses which run from six to twelve weeks, some in winter and some in summer, expressly

to prepare teachers or leaders for Girls' Canning Clubs and Home Demonstration Work. These courses cover cooking, canning, sewing, market gardening, poultry husbandry, plant propagation, and rural sanitation. Their good effects have been quickly demonstrated on a large scale.

Boards of health in several American municipalities and states have lately undertaken a large work of public teaching by means of widely distributed posters and leaflets on contagia and the carriers of contagious disease. They have found themselves obliged to take this action, because they learnt by experience that the spread of contagious disease can not be prevented by enacting laws and employing inspectors to procure the execution of those laws, unless the citizens themselves cooperate actively and with intelligence in the execution of the measures which applied biology prescribes. Thus, the public at large must be taught that if streets, yards, and vacant lots of a city are kept clean, garbage is removed promptly and kept covered till removed, and the privy vault and the manure-heap are abolished, the number of flies and vermin in and about dwellings will be much reduced. Reduction in the amount of sexual vice and venereal disease can be effected by teaching parents and young people about the dangers of syphilis and gonorrhea for the individual, and their fatal effects on family happiness.

Thirdly, this immense development of biological knowledge and skill must have lessons to teach about the means of other progress, similar or contrasted.

The most important lesson which the great advance in applied biological science teaches is that the treatment of human evils and wrongs in the future should be preventive for the mass, as well as curative for the individual. This is the reason for the great change which is taking place in the profession of medicine. The main functions of that profession are to be, not the curing of individuals who are already suffering from disease, but the prevention of the spread of disease from individual to individual in the community, and the eradication or seclusion of the causes, sources, or carriers of communicable diseases. The same great change needs to be wrought in all the callings which deal with prevention of crimes and misdemeanors. Society must concern itself, not chiefly with the isolation, temporary or permanent, of the individual murderer, thief, or forger, but with the extermination or repair of the genetic, educational, or industrial defects which cause the production of criminals. Since it is often found through medical and psychological examination that the prostitute, forger, robber or poisoner is physically as well as morally defective, it is probable that biological science will in the future contribute largely to the prevention as well as cure of such bodily defects, and hence of those moral defects which in an appreciable fraction of the population result in crimes. When humane persons learn, for example, that three fifths of all the prostitutes in New York City are feeble-minded girls and women, they become interested at once in the better care and treatment under medical direction of the feeble-minded, in the means of making a trustworthy diagnosis of feeble-mindedness in children, and in preventing the feeble-minded from reproducing their like. These are all biological problems; and the progress of biological inquiry during the past fifty years is sufficient to afford the means of solving on a large scale these fundamental social problems. It is to biological science in the departments of men-

tal disease and psycho-therapy, as well as to educational theory and practise, that we must look for new methods of discipline and education in prisons, reformatories, and houses of correction. Preventive medicine and sanitary reform have shown the right way of dealing with these chronic sores in the body politic.

The interrelations of the sciences are vividly taught by the history of biology during the past eighty years. Biological science is deeply indebted to physical science for the new instruments of precision which the biologist uses in determining and recording his facts. The telephone, the x-ray, and all the electrical apparatus for recording fluent observations and making certain note of very minute portions of time and space have been invaluable additions to the resources of the biological investigator. Many of the instruments which are indispensable in botanical and zoological laboratories were not invented for biological uses, but for physical or chemical uses. The dental practise called orthodontia has profited greatly by the use of the x-rays, because the Roentgenograph exhibits the precise abnormalities in the jaws and the concealed teeth which need to be remedied. The art of photography has contributed much to biological research and biological teaching, although developed and improved more for commercial and astronomical purposes than for biological. The microscope itself and the immersion lens, tools indispensable in the study of microorganisms of all sorts, were long used in pure botany and zoology, before they became the necessary tools of applied biological science.

Again, the long series of successful applications of biological science illustrates strikingly the impossibility of drawing any fixed line of demarcation between pure and applied science, or of establishing an invariable precedence for one over the other. Sometimes an application is suddenly made of one fragment of an accumulation of knowledge which pure scientists have made without thought of any application; and sometimes a bit of knowledge successfully applied stimulates pure scientists to enter and ransack the field from which the bit came. The latter process was strikingly illustrated when the large group of the mosquitoes was studied with ardor, because two species became famous, one as the carrier of malaria, and the other of yellow fever. The anatomy and habits of the typhus fever louse had been worked out many years before that insect became known as a carrier of typhus fever. Long before salvarsan was proved valuable for killing the syphilis microorganism in the human body, a series of organic compounds derived from benzol and containing arsenic had been elaborately studied, and the means of producing them made known by chemists who had not the faintest suspicion that a safe remedy for the most destructive of contagious diseases in the human species was later to be found in a new member of the series having a reduced arsenical potency. The pure scientist often feels, and not infrequently expresses, contempt for applications of science and for the men that make them. Sometimes the seeker for valuable applications of scientific knowledge feels no interest whatever in researches of which no industrial application seems feasible or probable, and confesses publicly this lack of interest. The facts seem to be that all such feelings are narrow and irrational; that no mortal can tell how soon a practical application of a scientific truth, which seems pure in the sense that it has no present application, may be discovered; and that, on the other hand, innumerable applications are nowadays made of truths

which five years or fifty years ago seemed as remote from all human interests as the observation attributed to Thales, that a bit of amber rubbed with a piece of silk would repel pith-balls suspended by fine filaments. Yet all magnetism and electricity with their infinite applications hark back to this experiment by Thales and to Galvani's observation of twitchings in a frog's legs.

The new physiological studies of the bodily changes accompanying or produced by pain, hunger, fear, and rage already promise a new interpretation of human behavior, and therefore a new policy for human society in regard to those emotions which, from primitive times to the present day, have been the source of enormous evils to mankind. The bodily changes which in man accompany these powerful emotions have only recently been in part made known; but it has already been made out with regard to a group of these alterations in the bodily economy that they may be regarded as responses adapted to preserve the individual, and to promote his bodily welfare or his efficiency. The emotions which a man fighting experiences call into sudden and potent action the muscular and nervous forces which he needs for both offense and defense. Hunger is a highly protective sensation. Fear stimulates muscular and nervous exertion, so long as the frightened animal can flee; but, if the animal is cornered, fear turns to fury, which develops the extraordinary strength of desperation. The successful study to-day of these bodily changes and reactions prophesies a better understanding in the future of the moral forces which make for rational conduct, and of the public policies in regard to war and peace which, long pursued, may gradually affect the sum of human misery or of human happiness.

The present terrible condition of Europe and the coincident sufferings of much of the rest of the world give fresh significance to the following remarks of Louis Pasteur at the inauguration of the Pasteur Institute at Paris in 1888:

> Two contrary laws seem to be wrestling with each other nowadays—the one a law of blood and of death, ever imagining new means of destruction, and forcing nations to be constantly ready for the battle-field; the other a law of peace, work and health, ever evolving new means of delivering man from the scourges which beset him. The one seeks violent conquests; the other the relief of humanity. The latter places one human life above any victory; while the former would sacrifice hundreds and thousands of lives to the ambition of one. . . . Which of these two laws will ultimately prevail God alone knows.

The whole civilized world observes with delight that the profession of medicine, including surgery and the profession of public health and sanitation, stands out distinctly among all the intellectual callings as being steadily and universally devoted to curing the sanguinary ills of war, alleviating human sufferings from disease and folly, and extending for mankind the domain of health and happy life. These professions employ all the resources of physics, chemistry and biology for merciful ends both in peace and in war. The martial professions, on the other hand, employ many scientific discoveries and inventions, originally made for peaceful uses, as means of destruction and death. Biological science has great advantage in this respect over physical and chemical. It can not so frequently or easily be applied to evil ends.

The development of public sanitation practise during the past fifty years has taught democratic communities important lessons on the just subordination of individual interests or rights to collective interests or rights, whenever the fulfilment of individual desires imperils the collective

security. Sanitary regulations often interfere with family management, the schooling of children, the transportation and selling of perishable goods, the established practises of mining and manufacturing corporations and of small tradesmen, and even the personal habits of the private citizen. These interferences are sometimes abrupt and arbitrary. On the whole, however, this teaching has been wholesome in the freedom-loving nations, in which individualism is apt to be exaggerated, and the sense of neighborliness and social unity needs to be quickened.

The rapid development of public sanitation has also given important lessons on promptly utilizing so much as we know of applied science, but also modifying our practises rapidly whenever the subsidiary sciences effect an advance. Forty years ago the filth and fomites theory was the basis of sanitary practise. Municipal and household cleanliness are still inculcated, but the emphasis on them is no longer exclusive. Then, bacteria and other disease-producing organisms became the chief objects of interest for sanitarians, and sanitary practise was based on knowledge of these organisms, and study of the media through which they reached man, such as the air, water, the soil, dust, milk and other uncooked foods. Isolation of all cases of contagious disease was much insisted on. Isolation is still useful in many cases; but it is not regarded to-day as the one effectual defense against epidemics and the diffusion of disease. Next, insect and vermin carriers were made known, and with them came in quite a new set of sanitary practises—not a replacement but a large addition. Lastly, the contact theory of contagion, with its demonstrations that living bacteria may be carried from one person to another in minute vesicles or droplets thrown off in coughing, sneezing, or any convulsive effort, and borne on the air, has gained general acceptance. At the same time, abundant proof has been given that pathogenic bacteria and protozoa develop in the bodies of many persons without causing any recognizable symptoms. Yet the virulence of the germs these persons carry may be extreme. These recent discoveries have introduced serious difficulties into some departments of sanitary practise. The apparently healthy carrier can not be isolated; for he remains unknown. If at any time such carriers and missed cases are numerous in a given community, isolation becomes useless, if not impossible. That is the ordinary condition of most American communities in regard to tuberculosis. Hence, bacteriologists have before them a very useful piece of work in the study of human carriers of disease who are not sick. Meantime sanitary practise is obtaining sound explanations of the occasional failure of its former methods of resisting epidemics, and preventing the spread of the ordinary contagious diseases.

The principal lesson to be drawn from the experiences of sanitarians during the past fifty years is that practitioners of any useful art must be prompt at every stage of progress to make use of knowledge just attained, even if it be empirical and incomplete, and must not linger content or satisfied at any stage. This lesson is applicable in every modern industry and educational or governmental agency during either peace or war.

Biologists are now realizing that biochemistry must furnish the fundamental knowledge of the processes which incessantly go on in the healthy body, and must also provide the exact knowledge of those changes in the normal processes which lead to disease and death. The physician and the sanitarian have become accustomed to

the beneficial use of remedies and defenses which chemistry at present can neither analyze nor synthesize, such, for example, as diphtheria antitoxin; but they are aware that this condition of their art is unsatisfactory and ought not to be permanent. The animal body consists of well-known chemical substances, and its functions depend on chemical reactions. Digestion is largely a chemical process. The animal body consists of innumerable cells in great variety, each of which acts under chemical and physical laws. Hence the belief of the biologist of to-day that chemistry—analytical, structural and physical—can and will come to the aid of the science and art of medicine in the large sense, and will ultimately enable biological science to comprehend the vital processes in health and disease, and to penetrate what are now the secrets of life and death.

Charles W. Eliot

THE BUREAU OF FISHERIES

The annual report of the Commissioner of Fisheries shows that the bureau has just completed the most successful of the forty-five years of its existence. The number of fish produced and distributed was greater, and the cost of production per million less, than in any previous year. Fifty permanent hatcheries and seventy-six sub-hatcheries, auxiliaries, and egg-collecting stations have been conducted and the output during the fiscal year 1915 was over four billion young fish and eggs, an increase of more than 241,000,000 over the previous year. Plants of food fishes were made in every state and territory; fish eggs were distributed to the fish commissions of twenty-seven states; and consignments of eggs were sent to Porto Rico, Cuba, India, and Japan. The distribution of the output required over 146,000 miles of travel by the five special cars of the bureau and 491,000 miles by detached messengers. The introduction of the hump-back salmon of the Pacific coast into Maine streams, which last year was an experiment, is now a reality, as many of these fish were taken during the summer of 1915 in the Maine rivers; furthermore, ripe eggs have been taken from them—a proof of thorough acclimatization. The counter-experiment of transplanting the Atlantic lobster in Pacific waters is still in progress.

The Bureau of Fisheries has done and is doing much for the conservation and utilization of food fishes which have heretofore been wasted. Each year when the Mississippi and Illinois Rivers, with their various tributaries, overflow their banks and later recede, millions of young fish are left stranded in temporary pools or where in a short time they would perish. Rescue work is, however, undertaken by the bureau, and in 1915 over eight million valuable food fish were saved and delivered to applicants, deposited in public waters, or returned to the main rivers.

The Alaskan seals are the most valuable herd of wild animals ever owned by any government, and the Bureau of Fisheries is their custodian. The revenue to the government from the seal skins—when commercial killing is resumed—will be very large, and efforts are being made to find uses for the seal carcasses, aside from the comparatively small number required by the natives for food. The old practise of using only the skin and wasting the carcass can no longer be countenanced. The report of the special investigators who went to the Pribilof Islands in 1914 to make a thorough study of the conditions of the seal herd was submitted in January, 1915, and presents in detail a statement not alone of the condition of the seal herd, but also of the fox and reindeer herds belonging to the government, and of the natives who inhabit the seal islands. A new method of obtaining supplies for the Pribilof Islands was instituted in 1914–15, and a large saving will result therefrom.

APPOINTMENTS AND DISMISSALS AT THE UNIVERSITY OF PENNSYLVANIA

As a result of the case of Professor Scott Nearing at the University of Pennsylvania, professors of the university appointed a com-

mittee to enquire into tenure of office there and elsewhere, and, as a result of their report, the trustees have passed amendments to the statutes, according to which as a rule professors shall only be promoted or appointed in consultation with the departments concerned. It is provided that there shall be four grades in the faculty: professor, assistant professor instructor and assistant. Professors are to be appointed for an indefinite term; assistant professors will receive a first appointment for three years and re-appointments for terms of five years; instructors and assistants will be appointed for one year. The section dealing with the removal of a professor or assistant professor follows:

A professor or an assistant professor shall be removed by the board of trustees only after a conference between a committee, consisting of one representative from each of the faculties in the university (such representatives being chosen by the faculty of which the representative is a member) and a committee of equal number from the board of trustees, at which conference the provost shall preside, and upon a report from such conference to the board of trustees for consideration and action by them.

THE PAN-AMERICAN SCIENTIFIC CONGRESS

As part of the second Pan-American Scientific Congress a number of receptions have been arranged, including the following:

December 30. 4:30 to 7 P.M. Reception by the president of the congress, the Ambassador of Chile, Senor Don Eduardo Suarez Mujica, at the Chilean Embassy, 1013 Sixteenth St.

December 30. 9 P.M. Reception tendered by the secretary and board of regents of the Smithsonian Institution to the members of the congress.

December 31. 8:30 P.M. Theater party by the Secretary of State and United States delegation to the Latin-American delegations at the New National Theater. Other members of the congress are requested to make their reservations at once with the management of the theater.

January 1. 9 P.M. Reception by the Governing Board of the Pan-American Union to members of the congress at the Pan-American Union.

January 3. 3 to 6 P.M. Reception tendered to the members of the congress by the president and officers of the Cosmos Club.

January 3. 8 P.M. The members of the Second Pan-American Scientific Congress will be the guests of the American Association for the Advancement of Science on the occasion of a special meeting to be held in Memorial Continental Hall.

January 4. 9 P.M. The trustees of the Carnegie Institution of Washington (16th and P Sts.) will tender a reception to the members of the congress.

January 7. Friday night the President will give a reception to members of the congress at the White House.

January 8. Saturday night (hour to be announced). The Secretary of State and the United States delegation will give a banquet to the members of the congress at the Pan-American Union.

SCIENTIFIC NOTES AND NEWS

THERE is published in this issue of SCIENCE the address given at Columbus by Dr. Charles W. Eliot, the retiring president of the American Association for the Advancement of Science. We hope to publish in subsequent issues other addresses given before the association and the other scientific societies meeting during convocation week, together with accounts of their proceedings.

PROFESSOR M. I. PUPIN, of Columbia University, has been elected president of the New York Academy of Sciences.

DR. W. P. HAY, of the U. S. National Museum, was elected president of the Biological Society of Washington at the annual meeting held in December.

DR. FRITZ HABER, director of the Kaiser Wilhelm Institute for Physiology, and Dr. Karl Bosch, of the Baden Anilin Factory, have received honorary doctorates from the Karlsruhe Technical School.

DR. LUDWIG RADLKOFER, professor of botany at Munich, who is now in his eighty-sixth year, has celebrated the sixtieth anniversary of his doctorate.

DR. PAUL BARTSCH and Dr. J. N. Rose have been selected as delegate and alternate to represent the Biological Society of Washington at the Pan-American Scientific Congress.

ACCORDING to the *Bulletin* of the American Geographical Society a letter received from

Carl Lumholtz, dated Batavia, Java, August 6, 1915, said that his plans for leaving Borneo with a party, about the middle of 1914, for exploration in Dutch New Guinea along the Digul River and among the interior islands had been defeated on account of the war. He was about ready to start when the governor-general informed him that he could not fulfill his promise to provide facilities until after the war. The explorer then visited India, where he spent seven months, chiefly at Benares. When he wrote, he was preparing for an expedition to central Borneo, the government supplying him with a photographer, two men to collect the zoological specimens and a small escort of soldiers. His destination was the mountainous region between the two northwestern tributaries of the Barito River, which empties into the Java Sea at the city of Banjermasin. He expected to start on August 14 and to return to Batavia in February or March next, when he hopes to be able to set out on his New Guinea explorations.

President Charles W. Dabney, of the University of Cincinnati, spoke last week before the Cincinnati section of the American Chemical Society, on "Reminiscences of Cincinnati Chemists." This meeting of two days celebrated the twenty-fifth anniversary of the founding of the section.

"The Scientific Work Developed by Dr. Nef" is the title of an address made in Chicago by Professor Lauder W. Jones of the University of Cincinnati on December 17, before the Chicago section of the American Chemical Society. The meeting was a memorial in honor of the late Professor J. W. Neff of the University of Chicago. Dr. Jones was a student and later a colleague of Dr. Nef in the University of Chicago.

On the initiative of the American Institution of Mining Engineers and the American Mining Congress, there will be held in Washington on January 15, a meeting of delegates from a number of scientific societies to arrange plans for a memorial to Dr. Joseph A. Holmes with a special view to favoring the ideals that he advanced for the increased safety of the mining and metallurgical workers and for the conservation of the mineral and natural resources of the United States.

Dr. Rudolph A. Witthaus, known for his work in chemistry and toxicology, who died on December 19, leaves most of his estate of more than $150,000 to the New York Academy of Medicine. Dr. Witthaus left to the Academy of Medicine all his books and the estate for the benefit of the library.

Professor Arthur Williams Wright, professor of experimental physics at Yale from 1872 until his retirement as professor emeritus in 1906, died on December 19 at his home in New Haven, in his eightieth year.

Sir Henry Enfield Roscoe, the distinguished chemist, emeritus professor in the University of Manchester, has died at his home in Surrey, aged eighty-two years.

A press despatch from Albany says that Governor Whitman has endorsed the work of Dr. Hermann M. Biggs, head of the State Department of Health, by approving practically all the requests for health extension work laid out for the coming fiscal year. Dr. Biggs has submitted requests for appropriations amounting to $626,525, as against $380,775 expended this year. The increased expenditures provided are largely for the departmental laboratories and for expert service.

According to a telegram from Chicago to the daily papers, the Illinois supreme court has upheld the decision of the appellate court and ordered the removal of the present board of directors of the American Medical Association. The decision is rendered in the suit filed five years ago by Dr. G. Frank Lydston, of Chicago, who claimed the affairs of the association were controlled by an oligarchy. He attempted to prevent Dr. George H. Simmons, of Chicago, then secretary of the association, from holding three offices at once. Under the ruling of the court, members of the present board of directors were elected illegally, inasmuch as the association was incorporated under a charter from Illinois and therefore must hold its meetings in that state.

DR. E. T. CRANE, editor of *Chemical Abstracts,* writes to members of the American Chemical Society that *Chemical Abstracts* has reached a critical stage in its development, a collective index being needed. The foreign chemical abstract journals publish either five-year or ten-year indexes. The adoption of a similar policy by *Chemical Abstracts* is essential if its value as a permanent record is not to be gradually lost. The completion of the tenth volume is the logical occasion for the appearance of the first collective index. Since the resources of the society are not sufficient to meet the needs of this expensive undertaking, it is necessary that at least a large part of the cost be guaranteed by advance subscriptions.

THE publication is announced of a quarterly *Journal of Cancer Research,* the official organ of the American Association for Cancer Research, to be edited by Richard Weil, Cornell University Medical School. The other members of the editorial committee are: Joseph C. Bloodgood, The Johns Hopkins University; Leo Loeb, Washington University; Ernest E. Tyzzer, Harvard University; H. Gideon Wells, University of Chicago, and William H. Woglom, Columbia University.

UNIVERSITY AND EDUCATIONAL NEWS

IT is now said that the estate left by Amos R. Eno is likely to amount to $15,000,000. Provided the will filed for probate on October 28 stands, in the face of the contest being made by Mr. Eno's next of kin, Columbia University's share of the estate will be about $7,000,000.

GRINNELL COLLEGE has received $50,000 from an anonymous donor in the east. The college is conducting a campaign for new endowment and buildings. Recently a parcel of land in Kansas City, valued at $150,000, was turned over to the college for the purpose of financing the start of a new men's dormitory system. The alumni of the college are raising funds for a new recitation building, the construction of which will be commenced next spring, which will cost in the neighborhood of $250,000.

A 550-TON locomotive has been presented by the Illinois Central Railroad Company to the University of Illinois. The university will use its new possession for instructional purposes and also for research work in its locomotive testing laboratory.

THE staff of the departments of physiology and biochemistry of the Fordham University School of Medicine has been reorganized and is now made up as follows: Lewis William Fetzer, Ph.D., M.S., professor of physiology and biochemistry; George F. Sheedy, Ph.B., M.S., assistant professor of physiology; Carl P. Sherwin, M.S., Ph.S., assistant professor of biochemistry; John Allen Killian, A.B., A.M., instructor in physiology and biochemistry.

AT a recent meeting the trustees of the University of Illinois promoted Dr. Trygve D. Yensen, in recognition of his work on the magnetic properties of iron and iron alloys.

DISCUSSION AND CORRESPONDENCE

A GALAPAGOS TORTOISE

A FEW facts of interest in regard to the Galapagos tortoise *Testudo vicina* Gunther, are hereby submitted as they have a bearing on the growth of a family which heretofore was believed to progress very slowly.

On April 20, 1914, we received by express from Riverside, Cal., a dead tortoise weighing 450 pounds. This specimen was brought from the Galapagos Islands in 1900 by Edmund Heller, who later accompanied Colonel Roosevelt on his African trip, and weighed at time of its capture in 1899 only 29 pounds.

It was taken to the home ranch at Riverside, Cal., where it died April 18, 1914.

Its death was reported to Edmund Heller, at Washington, who immediately donated it to the Museum of History, Science and Art, Exposition Park, Los Angeles, Cal.

The specimen itself was not only mounted but the entire skeleton was installed as a separate exhibit, the two forming a striking addition to the science wing of the museum.

The following extracts from Edmund Heller's letter in regard to the tortoise are of especial interest:

It is a real pleasure to learn from you that the Galapagos tortoise which you have recently re-

ceived from my brother at Riverside has met with so much appreciation at the Museum of History, Science and Art. The tortoise was a particular pet of mine, although a very stupid one. At Riverside during his residence of fourteen years he entertained a large number of visitors annually and was locally well known. I anticipated a very long life for the tortoise, at least a century, and his untimely death has been a great disappointment. The following data concerning the specimen will doubtless be of interest to you.

I found him in June, 1899, at Iguana Cove, Albemarle Island, Galapagos Islands. At the time of his capture he weighed 29 pounds, and was, I presume, not much over a year old. He was carried on the schooner, where he lived on the deck with several adult tortoises and fed on *Opuntia* cactus until we reached San Pedro Harbor. At Riverside he grew at a rapid pace during the first few years and doubled his weight annually—at the time of his death I should judge he was not over sixteen or seventeen years of age.

Mr. Ditmars, of the reptile department of the New York Zoological Park, states that several of his giant tortoises have died of inflammation of the kidneys, due to resting on damp soil, and this may doubtless explain the death of my specimen at Riverside.

You will find this tortoise referred to in a paper on "The Reptiles of the Galapagos Islands" by me published in the *Proceedings of the Washington Academy of Sciences*, February, 1903, Vol. 5, page 52.

There is no record of its size at time of capture, except as to weight, which was 29 pounds. At the time of its death it weighed 450 pounds and its carcass measured 41 inches long, 31 wide and 21 high. Mr. William Heller, who had personal care of the tortoise for many years, writes me that it thrived wonderfully on a diet of spineless cactus, milkweed, melons, oranges, etc.

Frank S. Daggett
Museum of History, Science and Art,
Los Angeles, Calif.

TWO PARTIAL-ALBINO BIRDS

On the first three days in October, in and near Webster Park, Orono, Me., there was observed a partial-albino robin (*Merula migratoria*). I examined it carefully with a field-glass. The white feathers are remiges, forming a white patch in each wing when the bird is standing. When the bird flies the fluttering white wing feathers give it a striking and beautiful appearance which must attract the attention even of the layman. In the left wing the white quills include all the longest primaries and extend far enough I think to number 12 or 13 all told. Among the lesser coverts of the left wing appear also two white spots, each apparently formed by the tip of a single feather. In the right wing the position of the white quills is different: the longest primaries (5 of them, I judge) appear perfectly normal; these are followed by about 7 white remiges. So far as I could see, the bird is in all other respects quite normal. The white terminal spots on the outer tail feathers are conspicuous, but not abnormally so. The white of the belly does not extend so far forward as I have seen it on some normal specimens. The white markings on the head, and the very narrow edgings of the breast feathers are as usual. The red of the breast is, I judge, both brighter and darker than the average. The bird is tame, frequents door-yards, and ought to be seen by other observers on its migration. To shoot such a bird and set up its skin in a museum is a wanton destruction of scientific material; if taken at all it should be taken alive and used for breeding.

On October 3, in Old Town, Me., I saw a partial-albino house sparrow (*Passer domesticus*), the white being in great masses on the wings, so that in flight this individual looks somewhat like a snowflake. In many years of bird observation I never saw another house sparrow with such an extensive albinism as this one.

Wallace Craig
University of Maine

ANOPHELES PSEUDOPUNCTIPENNIS

In the article entitled "The Rôle of *Anopheles punctipennis* Say in the Transmission of Malaria," which appeared in the issue of Science for December 17, 1915, an unfortunate error occurs. In discussing the work of Dupree and Knab's comments thereon it was stated that the latter was inclined to believe that the experiments had been conducted with

A. punctipennis. This term should have been *A. pseudopunctipennis,* which in fact is a species quite distinct from the *punctipennis* with which Dr. Dupree worked. W. V. KING

SCIENTIFIC BOOKS

Scientific and Applied Pharmacognosy intended for the Use of Students in Pharmacy, as a Handbook for Pharmacists and as a Reference Book for Food and Drug Analysts and Pharmacologists. By HENRY KRAEMER, professor of botany and pharmocognosy in the Philadelphia College of Pharmacy. One vol., pp. viii, 857, with over 300 plates comprising about 1,000 figures. Published by the author, 145 North 10th St., Philadelphia.

The writer well remembers the "Manual of Materia Medica" which was used at the Philadelphia College of Pharmacy as text in the middle of the eighties. Its author had gone beyond the mere description of the gross characteristics of the crude drugs and, following German example, had added *Lupenbilder* to his text. For the rest, it was a compilation of names and synonyms of plants, of constituents and properties, with a purely technical description of the part used as drug. It contained the bare facts which the student was expected to commit to memory. For review purposes, the student fell back on a booklet composed of synoptical tables. In justice to Professor Maisch it should be said that his personality and even his lectures were much more interesting than his text. Indeed, to the student who attended college with a real desire to improve himself, Professor Maisch was one of the principal incentives to aspire to higher ideals.

With even more vividness, the writer remembers a meeting of the Scientific Section of the American Pharmaceutical Association at which the author of the treatise under review read a paper on the teaching of pharmacognosy. Always sincere in what he presents and full of enthusiasm of his mission, the speaker carried away his audience, which apparently felt that a new day had dawned in pharmaceutical pedagogy.

If Bastin had already gone a step farther than Maisch, his successor seemed to feel that pharmacognosy was to be made an exact science by the histological study of drugs. His ambition was to drill his students so that, even in their dreams, they might recognize the fragments of tissues found in a mixed powder of several drugs and thereby identify the components. This was a highly ambitious program, the attainment of which might be realized by a few experts who had spent their lives in work of this kind, but was scarcely to be hoped for on part of the undergraduates. Moreover, such a course, even without the possible hope of attainment, is just as highly technical as the text of Maisch's "Manual." Neither should be the goal of the teacher of pharmacognosy. Fortunately for the teaching of pharmacognosy in the United States, Professor Kraemer, not many years later, repudiated his own position and came out boldly for the mastering of a few fundamental principles as opposed to the grind of a lot of technical detail.

The statutory definition of pharmacy and pharmacology by the department of education of the state of New York is exceedingly unfortunate and reveals, as well as any single incident may, the arbitrariness of educational standardization. It was not to be expected that a representative of the P. C. P. would be unduly influenced by legislation at Albany, yet we are grateful for the use of the word pharmacognosy rather than pharmacology as the characteristic word in the title. Both words mean etymologically the same, both stand for what may be regarded the same science, yet, whereas pharmacology represents the medical viewpoint, pharmacognosy represents that of the pharmacist. Both pharmacologist and pharmacognocist deal practically with the same subject-matter, but the point of emphasis of each naturally differs according to his professional viewpoint. The student of pharmacology wants to know about the vegetable origin of his drugs, he must know something about their chemical constituents, but the point of emphasis is that of physiological action. Wherever possible, it is the animal experiment that engages his attention as pro-

spective physician. As prospective pharmacist, the student of pharmacognosy wants to know that cinchona is a febrifuge, but he should know primarily what alkaloids are contained in cinchona bark and should have experience in the chemical assay for total alkaloids as well as for quinine. He should be posted on the botanical characteristics, both macroscopic and microscopic, of the drug and learn how to make the medicinal preparations and the reasons for a given method of preparation. Thus the students of medicine and pharmacy, in studying the same subject-matter, should have their subject presented from supplementary, not identical, viewpoints, so that later, as medical and pharmaceutical practitioners, their combined knowledge and experience may prove to the greater advantage of suffering mankind.

Both classes of students, however, should get something more than mere technical information out of these two courses. The mental discipline that should come from all scientific study should not be denied them. Moreover, the humanizing aspect should receive due attention. This is particularly true of the study of pharmacognosy. Possibly no science touches mankind at more points than does pharmacognosy. From the crude drug bale, with its interesting commercial history and even romance, to the working out of the structure of its physiologically active organic constituent and its administration, so many phases of human activity are involved that pharmacognosy may be regarded as one of the best examples of what may possibly be designated the modern scientific humanities.

In his Phi Beta Kappa address at Johns Hopkins the editor of Science made the following statement:

> That education is liberal which enlarges the sympathies and emphasizes our common interests, not that which forms an exclusive clique. On the whole the sciences in their application to human life seem more likely to form an adequate basis for a common culture than the dead languages.

This is certainly true of pharmacognosy. Teachers of history have gone beyond the mere history of wars and warring dynasties, they have even gone beyond the history of institutions and are touching upon certain phases of art as expressions of the evolution of man, but possibly not one has realized that the revolution in chemistry, brought about by Lavoisier, was possibly as important to mankind as the French political revolution, as a victim of which the great scientist was guillotined. Flueckiger was possibly the first to emphasize the humanizing aspects of pharmacognosy. In his "Handbuch der Pharmacognosie," Tschirch carried out the ideas of his master in word and picture, as might be expected of an artist of the camera as well as of the pen.

Compared with the masterpiece of the enthusiast in Bern, Henry Kraemer's "Scientific and Applied Pharmacognosy" falls short to such an extent that the two are not to be regarded in the same class either as to scope or as to execution. One grave mistake, however, which Tschirch made, Kraemer has avoided. Though Tschirch had been teaching pharmacognosy for a life time from the point of view of the botanist, when it came to the publication of his manuscript he adopted a chemical basis of classification of the material. Thus the attempt to place his work on what he apparently regarded a more scientific basis resulted in pseudo-science. Kraemer more fortunately arranges his material according to families.

A detailed criticism of a work like this does not seem called for in a journal like Science. Errors of statement can, no doubt, be found by any specialist who looks for them in his particular field. If the reader of this review will take the trouble to compare the text- and handbook under consideration with Tschirch's "Handbuch," still in the process of appearing in *Lieferungen,* he need not be told why the German masterpiece would not do as a text-book; nor need the inferiority in text, illustration and general make-up of the new American text be pointed out. One point, however, is noteworthy as a curious omission. Among the works consulted, the author in his preface does not even mention Tschirch, or his predecessors Flueckiger and Hanbury. While, so far as illustrations are concerned, the author has apparently endeavored to impart to his treatise

what may be regarded as a laudable American aspect, it can scarcely be thought possible that he has not consulted, and consulted freely, every fascicle of Tschirch's "Handbuch" as it has been issued from the press. Though the present unfortunate war is teaching us how derelict we have been in making ourselves independent of Europe, so far as vegetable drugs are concerned, yet the pharmacognocist, above all, should ever be mindful of the inscription on the Flueckiger medal: *Scientia non unius populi sed orbis terrarum.* E. K.

Practical Oil Geology. By DORSEY HAGER. McGraw-Hill, New York, 1915. Pp. xii + 141; figs. 76, three being full page, and one plate. $2.00 net.

This handy pocket book puts the stock-in-trade of the petroleum geologist and engineer before the petroleum investor in a way that invites friendship. Further, it lays sound ideas of applied structural and stratigraphical geology before a class which is glad to substitute such revelations for the "luck" of the oil (or water) wizard.

While the space is so small as to call for brevity at the expense at times of clearness, the numerous excellent cuts—most of them evidently the author's—more than balance in field ingenuity and the applications of pure geology what may be wanting in the way of academic clarity of statement.

Only two or three proof errors appear in the text proper. An early second edition for so good a book on a timely subject seems sure, and in the reappearance no doubt there will be weeded out such oversights as: "Igneous rocks, or volcanics," p. 28; "a level line in the plane of the horizontal," p. 71; "curved axis," fig. 50 and p. 86; Comanchean equivalent to the whole Mesozoic, p. 38. Certainly the errors in Table XI. will not be recopied, nor perhaps that in averaging the viscosity of Oklahoma oils, especially the unfair inclusion of the high viscosity from Wheeler, Table VI. Convenience would be served by referring to a figure on a definite page rather than, say, "(See Fig. 19, Chapter III.)."

Useful adaptations for the layman are: Geological Names (Kemp); Mathematical Tables (Hayes); Tests for Oil (Woodruff); Favorable and Unfavorable Indications for Oil (Craig); Definitions of Formation and Member (Snyder). Other tables and data will-serve more technical needs, and the cuts will doubtless be freely drawn upon by other authors.

The neat and convenient get-up, and strong, leather binding are characteristic of these publishers.

CHARLES T. KIRK
STATE UNIVERSITY,
ALBUQUERQUE, NEW MEXICO

SPECIAL ARTICLES

ON THE RELATIVE NUMBERS OF RHIZOPODS AND FLAGELLATES IN THE FAUNA OF SOILS

THE investigations upon the protozoan fauna of the soil and its interrelations with the bacterial flora therein contained has opened a new field of exploration and suggested a new line of attack for the problem of "sick soils." The work of Russell and Hutchinson and their school indicates that the constituents of the protozoan fauna, notably the amœbas, affect appreciably the bacterial content of the soils they inhabit, and thus impinge upon some of the problems of fertility. This line of evidence has stimulated many preliminary investigations into the extent, distribution and qualitative make-up of the protozoan fauna of the soil. In many cases these attempts at the qualitative determination of these organisms have gone no farther than to record the relative numbers of the individuals belonging to the groups of rhizopods, flagellates and ciliates, with occasional questionable identifications of a few genera or more rarely still of species. The purely preliminary status of such investigations is readily inferred by those familiar with the fields of bacteriology, immunity and protozoology. Valid conclusions here can rest only upon a knowledge of the fauna which extends to an accurate determination of the species concerned and of their feeding habits or symbiotic relationships to the bacterial flora, which may be even more subtle than the gross phase of food relations.

One naturally recalls in this connection the

similarities of *Entamœba coli* Lösch and *E. dysenteriæ* Councilman and Lafleur, and their long-standing confusion in the biological and medical literature, notwithstanding the very profound differences between them in their relations to their human host, the one a harmless parasite, the other a serious factor in disease. The conquest of amœbic dysentery was conditioned by the discovery of the differences between these two species, and the relations of each to their common host.

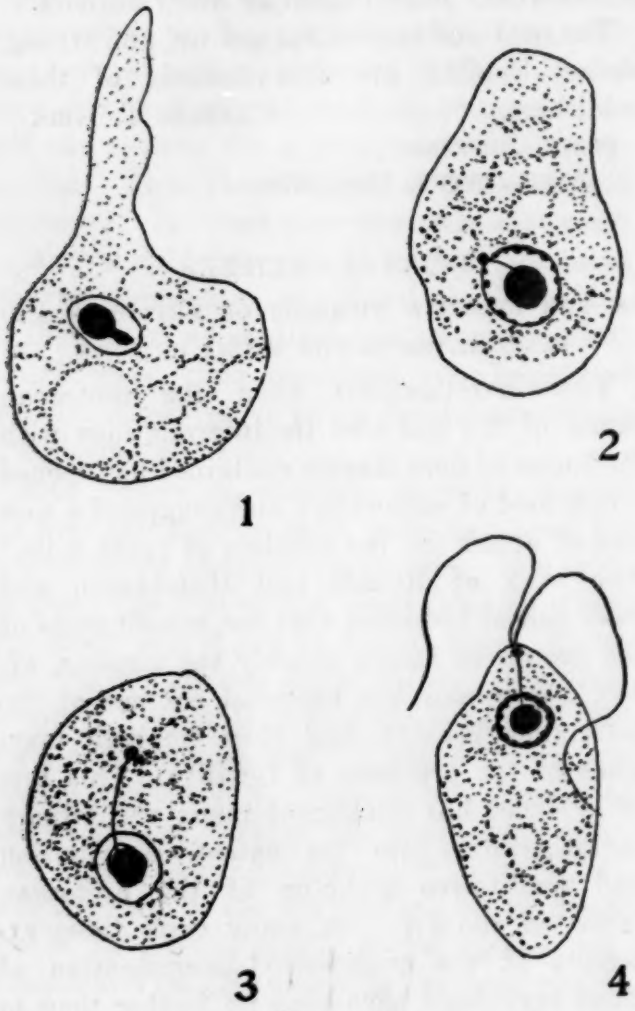

Fig. 1.

The relationship of *Entamœba buccalis* to Riggs' disease, or pyorrhea, is not only a problem in parasitism, but probably one also of the commensal relationship of this amœba and the bacterial flora of the gingival abscesses.

The remarkable and unique protozoan fauna of the first and second stomachs of the ox and other ruminants is composed of not less than 6 genera and 24 species living together in closest proximity in a common medium, but their relationships to it are not uniform. One species of the genus, *Diplodinium ecaudatum,* is, for example, exclusively a bacterial feeder (see Sharp, 1914), while others in the same genus feed indiscriminately on other components of stomach contents.

Indeed it is not impossible that, as in the case of pathogenic protozoa and bacteria, there will be found to be strains or pure lines within the species, whose ecological relationships may be so different among themselves as to lead to divergent conclusions regarding the species.

These facts lead to the inference that the mass treatment of the protozoan fauna of the soil without regard to its component species will tend to obscure and confuse its relationship to the bacterial and other flora, to the chemical conditions related thereto, and to the problem of sick soils and of fertility.

In a recent survey of the literature on the protozoa of the soil I have been struck by the great divergence of results at the hands of different investigators as to the nature and extent of the protozoan fauna discovered by direct examination and by culture methods. To the student of the ecology of the protozoa this divergence is to be expected in view of what is known of the seasonal fluctuations in numbers and kinds of protozoa in the population of reservoirs, ponds, lakes and streams. Adjacent bodies of water may have a very different seasonal history in these respects as I have shown (1904, 1908) with regard to the plankton of the Illinois River. Furthermore these minute organisms are very susceptible to infinitesimally small doses of certain mineral salts, notably copper sulphate. A treatment of a reservoir with this salt to the amount of only one part to ten million by weight will completely kill out most flagellates having chlorophyll in any of its forms in their organization and result in a total reorganization of the microfauna and microflora of the body of water thus treated, which persists for several months at least. Add to the seasonal fluctuations in heat and moisture and the local differences in chemical composition, the access of adventitious substances in rainfall, tillage, fertilizers, flood waters and seepage, and it is

not strange that the protozoan fauna lacks uniformity. The chemical decompositions in the soil itself, its gaseous content, the antagonisms of certain salts, the demands upon the soil by its superterranean flora, the fluctuating bacteria and molds, the ravages of nematodes and the toxin and excreta of all of the organisms living therein and thereon, all form a part of the agencies potent in modifying, stimulating or depressing the protozoan fauna as a whole, and its several elements differentially.

One of the principal points brought out by recent investigations has been the relative numbers of flagellates and amœbas, the main interest centering in the latter because of their possible action as bacterophages of bacteria active in fixation of atmospheric nitrogen. The late C. H. Martin, whose death at the Dardanelles is an irreparable loss to the science of protozoology, has shown (1912) that one flagellate, *Monas termo* Ehrbg., is associated with the occurrence of certain "sick soils" in Great Britain, but little precise work has been done as yet elsewhere upon the flagellates of the soil.

Two papers published recently are typical of the divergences of results with respect to the relative abundance of amœbas and flagellates in the normal fauna of soils. Cauda and Sangiorgi (1914) in soils from rice localities find that amœbas are the prevailing forms, were present in all localities, and were exceeded in numbers by the flagellates in one case only. Flagellates together with the ciliates were sometimes entirely absent. On the other hand, Sherman (1914) concludes that the active protozoan inhabitants of most soils are probably restricted to the flagellates, that they constitute the greater portion of the protozoan fauna of the soil, and that the amœbas do not ordinarily occur in numbers nearly as great as do the flagellates. Both of these conclusions may well be correct *for the soils examined,* but I wish to cite facts which necessitate caution in making sweeping conclusions from such data and to set forth a new factor not as yet considered, in so far as I can infer from the literature, by any investigator of soil protozoa. The absence of its consideration tends to weaken or possibly even to vitiate conclusions as to relative numbers of amœbas and flagellates.

Certain investigations carried on in my laboratory by Dr. Charlie W. Wilson (1915) on the life history of a soil amœba have a direct and, it seems, an important bearing on this problem of the seeming relative numbers of amœbas and flagellates. I use the term "seeming" advisedly for the investigations prove that the common soil amœba, *Nægleria gruberi* (Schardinger), has a biflagellate phase, and enflagellates and exflagellates rather quickly on slight provocation under the conditions of laboratory culture. Not only do single individuals undergo these transformations but the whole mass of the culture may do so. The bearing of this fact upon the reported difference in the flagellate and rhizopod components of the protozoan fauna of the soil is self-evident.

This amœba (Fig. 1) is a small organism (8 μ to 30 μ) with one broad blunt pseudopodium or sometimes several blunt ones, and one subcentral nucleus. When it enflagellates the karyosome sends out a chromatic process (Fig. 2) which traverses the nuclear membrane, forms a marginal blepharoplast, and emerges as two long flagella (Figs. 3, 4). The body assumes a rigid asymmetrically curved shape and the organism swims away in the typical spiral course. When it exflagellates the flagella shorten and thicken and retreat into the cytoplasm and the blepharoplast returns to the karyosome within the nucleus. It takes about 70 minutes for a culture of amœbas to become one of flagellates, while the reverse process is somewhat longer and less uniformly followed by the individuals in the cultures. The addition of water, or fresh culture medium (filtered and sterilized soil and manure infusion) or the access of air, tends to induce enflagellation, but exflagellation is less definite in response to their opposites. Fission, budding, encystment, excystment and chromidial extrusion occur frequently and rather quickly.

These processes and the flagellate stage are evidently adaptive phenomena fitting this organism to a life in the soil with its vicissitudes of fluctuating food supply, alternations

of drouth and moisture, and changing chemical and physical conditions.

This amœba was recovered by Wherry (1913) from the water-supply of the adjacent city of Oakland, California, but it is primarily, in our experience, a soil amœba, found in undisturbed alluvial soil along Strawberry Canon on our campus, in garden soils and appears to have its maximum abundance at a depth of about four inches, though it was also recovered on our campus from clay and rock talus *in situ* in the sides of the excavation for the Sather Campanile to a depth of over twenty feet. It has also been found in cultures from various ranch soils from the central valleys of California.

It is not distinguishable by any morphological characters from a species described by Schardinger (1889) as *Amœba Gruberi* from human feces in a case of dysentery at Vienna, Austria. There is evidence that this author used pure culture methods. It is possible, however, that the cysts might have taken in food or water and have passed intact through the digestive tract and then have been recovered from the feces in the culture, but contamination from dust or water are equally open as possibilities. All of these facts taken together lead to the inference that this amœba, *Nægleri gruberi* (Schardinger), may have a wide distribution in the soil and to be cosmopolitan in its occurrence. If this proves to be the case, or if other amœba of the soil have similar flagellated stages, it is obvious that future investigations of the relative distribution of amœbas and flagellates in the soil should be so conducted as to avoid the complications in interpretation and conclusions involved in the Jekyll-and-Hyde life history of this organism.

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Charles A. Kofoid

Zoological Laboratory,
University of California

The Native Habitat of Spongospora Subterranea

The discovery of *Spongospora subterranea*, the powdery scab organism, on recent importations of potatoes from Peru by the Department of Agriculture has furnished important evidence bearing on the question of the origin of this parasite. *Spongospora* is widely distributed in Europe and within the last three or four years has established itself in several widely separated localities in the United States and Canada, but the problem of its origin has remained unsolved.

Kunkel's[1] recent work on *Spongospora* has demonstrated that a very intimate relation exists between the host cells and the parasite.

[1] Kunkel, L. O., "A Contribution to the Life History of *Spongospora subterranea*," *Jour. of Agr. Research*, 4: 265–278, Pls. XXXIX.–XLIII., 1915.

The latter does not cause a rapid destruction of host tissue such as is seen in many cases of recently established parasitism, but rather produces a temporary conservation of the host cells followed by their gradual destruction, in short, the type of development to be expected in parasitism of long standing. Hence we may safely conclude that the association of *Spongospora* and the potato is an ancient one, and we should therefore naturally look for the original home of powdery scab in some very early habitat of the potato. In 1891 Lagerheim[2] collected *Spongospora* in Quito, Ecuador, and stated that the disease was well known in that region, but he gave no evidence bearing on the question as to whether it had long existed there or had been recently introduced, possibly from Europe, where it has been known to exist since 1841. Evidence on this question is now at hand.

Mr. O. F. Cook, of the Bureau of Plant Industry, recently returned from South America, bringing specimens of a large number of native varieties of potato from Peru. When these collections were examined by the undersigned pathological inspectors of the Federal Horticultural Board at Washington, about one third of the tubers were found to be affected with powdery scab. Their identification of the organism has been verified by Mr. C. W. Carpenter of the Bureau of Plant Industry. The diseased tubers came from the eastern slope of the Andes, all having been grown at altitudes of 10,000 feet or more in the regions about Cuzco and Ollantaytambo, Peru. Some of the infected tubers were obtained direct from the fields of the Indians near the upper limit of potato cultivation in the Panticalla Pass, between the Urubamba and Lucumayo valleys, at an altitude of over 12,000 feet. Mr. Cook states that potatoes are never imported in these localities, only the original native varieties being grown. Hence introduction of the disease from Europe or any other foreign locality into this region of primitive potato-growing seems most improbable. Both host and parasite are apparently indigenous.

[2] Lagerheim, G. de, "Remarks on the Fungus of a Potato Scab (*Spongospora solani* Brunch)," *Jour. of Mycology*, VII., 103–104, 1892.

Further evidence tending to show that the disease is native to Peru and not introduced is furnished by the character of the disease itself as it develops on the Peruvian potatoes. The sori are in general smaller and shallower than those usually produced on most varieties of European or North American tubers, and show less destruction of host tissue, indicating that the disease is not of a serious nature in Peru. This inference is strengthened by Mr. Cook's statement that the natives are not concerned over the disease, in fact do not consider it an injury. That the fungus is common and generally distributed is proved by the fact that about one third of the tubers collected in this region showed *Spongospora* sori. The slight importance of the disease in Peru as compared with its greater virulence in Europe and North America is easily understood if South America is the native habitat of the parasite. Ancient association of the host and its parasite would naturally have developed a high degree of resistance on the part of the potato and have produced the balanced relation of host and parasite so commonly seen in cases of long-established parasitism.

The evidence indicates, therefore, that South America, which is the native habitat of the potato, is also the home of *Spongospora*. If so, we may add one more organism to the already long list of parasites which are relatively unimportant in their native habitats, but which have developed greater virulence and destructive power when introduced into new regions, especially if in the new localities the host plants have been subjected to more intensive cultivation.

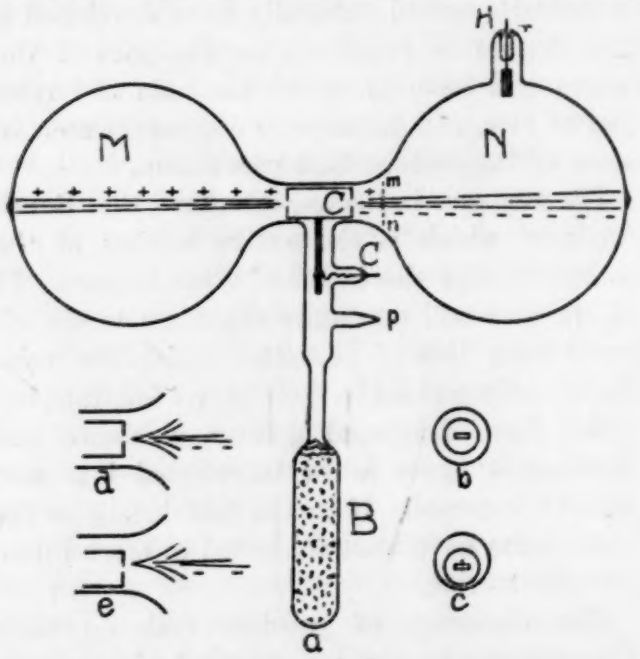
The discovery of powdery scab on these Peruvian potatoes shows the need of very careful inspection of all imported plants and emphasizes the great importance of obtaining healthy material for breeding or other experimental purposes. Such material should be entirely free from disease, even from diseases which are apparently of little importance in the native habitat of the host.

G. R. LYMAN,
J. T. ROGERS
FEDERAL HORTICULTURAL BOARD,
U. S. DEPARTMENT OF AGRICULTURE

COLOR EFFECTS OF POSITIVE AND OF CATHODE RAYS IN RESIDUAL AIR, HYDROGEN, HELIUM, ETC.

As is well known positive rays have their origin in front of the cathode, and under the action of the electric force fall toward it. If the cathode is perforated the rays stream through and constitute the "kanal strahlen" of Goldstein. Tubes built to exhibit this phenomenon form a part of the regular equipment of nearly all collections of apparatus intended to exhibit the phenomena of electric discharge through gases.

Most beautiful and striking color effects may be had by using hollow cathodes[1] in specially designed tubes containing each a trace of some inert gas such as helium, argon or neon. The color effect is striking because the cathode beam is of one color, while the positive ray beam in the same gas is of an entirely different color. The general design of the tubes that Dr. Jakob Kunz and the writer



have found best suited is shown in the accompanying figure. The discharge tube is dumbbell shaped. It is made of two 2 liter Florence flasks, *M* and *N*. The hollow cylindrical cathode *C* is mounted in the neck, while the anode *A* is placed in one of the bulbs. The cathode terminal *C*, the nipple *p* for exhausting, and the charcoal bulb *B* are all attached to one vertical tube as shown.

The process of filling the discharge tube, sealing it off from the pump, and its subsequent use is as follows: After the tube is constructed, and the charcoal bulb *B* attached, the exhaust nipple is put in communication with a pump, and also to some source of the gas to be used. During the early part of the exhaustion it is well to gently heat the bulb *B*. Continue the pumping until the tube on sparking shows a tendency of becoming hard. As this stage is approached cathode rays will appear as a compact beam in the bulb *N*, while a beam of positive rays will traverse the bulb *M*. Now admit a small quantity of the desired gas, say, helium. The chances are that too much gas will enter the discharge tube and thus destroy the definition of the two beams. To restore it pumping should be continued and at the same time the bulb *B* should be carefully submerged in liquid air. Care must be exercised not to reduce the content of helium by too long continued pumping. The cooled charcoal will absorb the traces of air leaving the tube *MN* relatively richer and richer in helium—since helium, an inert gas, is but slightly absorbed by the cooled charcoal. The cathode beam in *N* as well as the positive ray beam in *M* will each increase in brightness and definition, reaching a maximum, after which, as the process continues, they will begin to fade. At the stage when the beams are judged brightest the exhaust nipple *p* is sealed off from the pump. The tube is now in its finished state. Removing the liquid air, the charcoal gives up its absorbed gas and the beams weaken and become diffused. For subsequent use it is only necessary to submerge *B* in liquid air while the discharge from an induction coil is passing. The beams in *M* and *N* will increase in brightness and definition as the absorption of the active gases proceeds, thus giving ample time for the observation of the changes going on within the tube.

The most interesting phenomenon is the *color* of the two beams. The cathode beam in helium is a greenish gray color, while the positive ray beam in the *same* gas is a beautiful red. There is no mistaking the colors. Indeed the red due to the positive ions is so persistent that it appears at the very origin of these rays—at the edge of the Crookes dark

[1] J. J. Thomson, "Rays of Positive Electricity," p. 6, 1913.

space in front of the cathode (shown by the dotted line *mn* in the figure).

The usefulness of the above described tube for many laboratories is limited because liquid air is used in its initial adjustment and subsequent operation. If desired the bulb *B* may also be sealed off. The only disadvantage is that this fixes the gas content in the tube. In case no liquid air is available it is still possible to construct the tube provided access may be had to a good pump. In this event the discharge tube should be washed out several times with the desired gas, in order to remove every trace of air, and then sealed off when the beams are brightest. This gives a permanent tube provided the occluded gases in the electrodes and walls of the vessel do not in time let the vacuum down. Danger from this source, however, may be largely avoided by gently heating the tube during exhaustion. The obvious advantage of a charcoal bulb is that the proper exhaustion can always be reached and at the same time the discharge at various stages of exhaustion successively exhibited.

It should be added that the best results only are obtained when the hollow cathode *C*, which is an aluminum cylinder closed at the ends with aluminum discs through the center of each is cut a rectangular opening about 1 mm. by 6 mm., is placed exactly on the axis of the tube connecting the bulbs *M* and *N*. The correct position is shown in the figure, end view at *b*, and side view at *d*. The discharge leaving the cathode, confined in a narrow tube as here, is always along the axis of the glass tube, regardless of the alignment of the cathode. In other words, the shape of the glass tube rather than the shape of the cathode determines the position of the cathode beam. Lack of alignment is shown at *c* and *e* where the opening through the hollow cathode is below the axis and as a result few positive rays get through and show in the bulb *M*, though they show distinctly at their origin in front of the cathode. To avoid possible lack of alignment it is advised to make the hollow cathode *C* of such diameter so as to fit snugly into the neck connecting *M* and *N* as shown in *a* of the figure.

An interesting test to show that the beam in *N* is composed of electrons, and that in *M* of positively charged ions, is to deflect them in turn by a strong electro-magnet. The cathode beam is readily deflected while the positive ray beam is but little deflected and that in the opposite sense. This is in full agreement with the theory of the magnetic deflection of moving positive and negative charges.

CHAS. T. KNIPP

LABORATORY OF PHYSICS,
UNIVERSITY OF ILLINOIS,
October 9, 1915

THE AMERICAN CHEMICAL SOCIETY

THE fifty-first meeting of the American Chemical Society was held in Seattle, Washington, August 30 to September 3, 1915, inclusive. The members came to Seattle from many directions, although a special car brought thirty-three over the Great Northern railroad on the evening of the thirtieth. Those who came in the special car spent August 29 in Glacier National Park. The meeting was opened by an address of welcome by the dean of the University of Washington, to which response was made by President Herty. A general meeting was then called to order and listened to an address by Leo H. Baekeland on "Chemical Industry" and a second address by H. K. Benson on "Industrial Resources and Opportunities of the Pacific Northwest." Following these addresses the society continued in general session until noon of the following day, holding public symposiums.

On Wednesday afternoon the various additional programs were held as well as the election of additional officers for 1916. On the evening of the thirty-first a complimentary smoker was given by the Seattle Commercial Club, at which Professor Meany gave a beautifully illustrated lecture with colored slides on Mt. Rainier. The members were also entertained by a Japanese sword contest and by a Chinese cartoonist. Besides the usual attractions of the excursions and the President's address, the ladies were given special entertainment of a reception and tea on the university campus Tuesday, August 31, and an organ recital the same evening. On Wednesday they were given a special drive by automobile through the parks and boulevards of Seattle. On Wednesday the members were treated to an automobile trip through the beautiful parks and boulevards of Seattle and on Wednesday evening at 8 o'clock, President Charles H. Herty gave his presidential address, entitled "Co-

operation in Matters Chemical,'' before a large audience. On Thursday a complimentary excursion was made on a specially chartered steamer on Puget Sound and refreshments were served to members and guests present. Thursday evening a subscription banquet closed the regular meeting of the society, although other excursions were enjoyed on Friday.

On Friday, September 3, a portion of the members were taken by private yachts on Puget Sound to Tacoma and visited plants there, while a party of twenty-nine took automobiles from Tacoma to Mt. Rainier National Park, over one of the most beautiful drives in America. Saturday spent in Portland as the guests of the Oregon Section. The members were met at the train at 8 A.M. and were taken direct to one of Portland's hotels, where a complimentary breakfast was served. By automobile the members then visited either the new Gas Plant of the city or the Willamette Paper Company works at Oregon City. Following these visits, the members met for a complimentary luncheon at Portland's most beautiful Country Club. After lunch the members were shown around Portland by automobile and met at 4 o'clock to listen to a lecture by Messrs. Burger and Jones, illustrated by colored photography lantern slides showing scenes along the Columbia River and views of Mt. Hood and Mt. St. Helens. This set of views is probably the most remarkable and beautiful chemical reproductions of nature that have ever been shown before an audience. The day was thoroughly enjoyed by members present. On September 5, twenty-five members who had come through together to San Francisco were entertained at dinner at Techau Tavern by the members of the California Section in the usual hospitable manner so characteristic of California chemists. The registration at Seattle showed the presence of 106 members of the society and 119 guests.

The following papers being a continuation of series of papers first presented at New Orleans on the Chemists' Contributions to Industry, were printed in the November *Journal of Industrial and Engineering Chemistry:*

The Contributions of the Chemist to the Naval Stores Industry: John E. Teeple.

Contributions of the Chemist to the Iron and Steel Industry: George W. Sargent.

Contributions of the Chemist to the Iron and Steel Industry: A. S. Cushman.

Contributions of the Chemist to the Art of Soap Making: M. H. Ittner.

Contributions of the Chemist to the Perfumery Industry: E. T. Beiser.

Contributions of the Chemist to the Lead Industry: G. W. Thompson.

Contributions of the Chemist to the Paint and Varnish Industry: Maximillian Toch.

Contribution of the Chemist to the Photographic Industry: Francis C. Frasy.

Contributions of the Chemist to the Pharmaceutical Products Industry: Frank R. Eldred.

Contributions of the Chemist to the Hardwood Distillation Industry: S. W. Katzenstein.

Also the following papers comprising a symposium on the Chemistry of Wood Waste were printed in the November *Journal of Industrial and Engineering Chemistry:*

Chemical Engineering of the Hardwood Distillation Industry: James R. Withrow.

What Chemistry has done to Aid the Utilization of Wood: S. F. Acree.

The Tannin Content of Pacific Coast Conifers: H. K. Benson and T. G. Thompson.

A study of the tannin content of hemlock, spruce and Douglas fir from western Washington was made. Local tanneries use the bark of the western hemlock, which contains above 15 per cent. tannin in commercial practise. From sawmills operating under average conditions bark, slabs and sawdust from cross-cut saws were obtained. These were sampled, extracted and analyzed according to the Official Method of the Leather Chemists' Association. The results of the analysis for tannin reported on a dry basis are as follows:

	Per Cent. Tannin
Fir bark	6.34
Fir slab	5.92
Fir sawdust	1.06
Fir cambium layer	9.92
Spruce bark	5.88
Spruce slab	3.69

Inasmuch as the tannin content of the fir slab approaches that of chestnut wood (6.62 per cent.) and owing to the low cost of fir slabs (less than $2 per cord), it is believed that the extraction of tannin from fir slabs is a commercial possibility. A local tannery used fir extract in the tanning of sheep-skin and reported good quality and a color similar to that obtained from oak tannin.

Yields of By-products from Destructive Distillation of Some Western Conifers: H. K. Benson and Marc Darrin.

The following classes of woods were treated at the Forest Service distillation plant at Seattle:[1]

[1] For design see *Jour. Ind. Eng. Chemistry,* Vol. 5, No. 11.

(1) Douglas fir common run mill waste, (2) Douglas fir selected mill waste, (3) Douglas fir common run stump wood, (4) western yellow pine common run mill waste, (5) western yellow pine common run stump wood, (6) western hemlock common run mill waste. The highest yield of wood alcohol was 5.00 gallons per cord from the hemlock; the lowest 1.83 gallons per cord from the pine stumps; the average yield from Douglas fir common run mill waste was 3.90 per cord against 2.60 from the stumps. The highest yield of acetate of lime was likewise in the case of the hemlock, being 94.0 pounds per cord; the lowest was 55.8 for the fir stumps. This figure was close to that for the pine stumps at 60.8. The yield for the fir common run mill waste was 75.0 pounds per cord, against 74.3 pounds for the selected. The selected Douglas fir mill waste had by far the greatest yields of oils of a turpentine character, being 10.86 gallons per cord. The lowest yield was 2.76 for hemlock. The yield for the fir common run mill waste was 3.40 gallons against 5.59 for the stumps; 4.91 for the pine mill waste, and 6.06 for the pine stumps. Likewise, the selected fir mill waste had the greatest yield of tar, being 46.37 gallons per cord; the lowest yield was 19.88 for the Douglas fir stump wood. The other yields ranged close to the last figure, the largest being 27.80 for the Douglas fir mill waste. The highest yield of charcoal was 977 pounds for the Douglas fir common run mill waste. This figure was followed by those for hemlock and the selected Douglas fir at 938 and 900, respectively. The lowest yield was for pine, being 478 and 520 pounds for the mill waste and the stumps respectively.

From this data the authors find that the most suitable wood for distillation is the Douglas fir selected mill waste, followed by the Douglas fir common run mill waste.

The Use of Ammonium Hydroxide for Extraction of Rosin from Wood: H. K. BENSON AND HERBERT N. CRITES.

A five per cent. solution of ammonium hydroxide was used to extract resinous fir wood. Practically complete extraction was obtained when the chips were covered in pressure bottles with a quantity of the ammonia solution equal to eight times the weight of the wood at a temperature of 70° C. for five hours. The chips were washed with a quantity of five per cent. ammonia solution equal to twice the weight of the wood to recover the one per cent. rosin adhering to the chips. Rosin dissolves in ammonium hydroxide to form ammonium resinate, which upon heating to 100° C. decomposes, forming ammonia and leaving a residue of rosin and "humus." The ammonia is recovered by the method used in gas works and again used in the process. The mixture of rosin and "humus" is then agitated with gasoline, whereby the rosin goes into solution from which the "humus" is removed by filtration. The rosin solution is evaporated, the gasoline being condensed and recovered and the molten rosin run from the still into containers, where it solidifies upon cooling. The "humus" is in the form of a brown powder and other investigations show its suitability for the manufacture of dyes. From resinous fir wood 700 pounds rosin and 500 pounds "humus" per cord were obtained.

Discoloration of Maple in the Kiln: ROY C. JUDD.

The Chemical Composition of the Light Oil from the Destructive Distillation of Resinous Woods: R. E. ROSE AND A. G. BISSELL.

The Manufacture of Ethyl Alcohol from Wood Waste. II. The Hydrolysis of White Spruce: F. W. KRESSMANN.

A continuation of the work previously prepared has shown first that the ratio of water to dry wood is without appreciable influence as long as sufficient water is used to dilute the acid so as to give an intimate mixture of acid with wood. In the former work, the ratio of water to dry wood was 400 to 100, which has been reduced to 100 to 100, although the ratio of 125 parts of water to 100 parts of dry wood is recommended, since this will give a digested sawdust free from drip. The ratio of the catalyzing agent (sulphuric acid) to dry wood has been varied from 5 parts per thousand (0.5 per cent.) to 40 parts per thousand (4 per cent.). Two and one half per cent. of acid was found to give the best results, considered both from a total sugar and from fermentable sugar standpoint. The variation of the concentration of catalyzing agent in the water added was found to be without effect so long as the actual amount of catalyzing agent as compared to the dry wood was not varied. With instantaneous cooks and with increasing concentration with sulphuric acid, the yield of alcohol increased from 4.17 per cent. with .5 per cent. sulphuric acid up to 7 per cent. with 4 per cent. sulphuric acid. It was found, as reported previously, that the sugar yields did not vary with the time of cooking, but more careful fermentation work has shown that although the total sugar yield does not vary appreciably, the percentage of that sugar which is fermentable increases with increased time of cooking. A 20-minute cook at 7½ atmospheres pressures with 2½ per cent. sulphuric

acid and 125 per cent. of water gave an alcohol yield of 8.54 per cent. of the dry weight of the wood or about 25 gallons per dry ton.

The Application of the Davis Spot Test in the Preliminary Examination of Creosotes: Homer Cloukey.

Isoprene from Beta-pinene: A. W. Schorger and Ralph Sayre.

The Distillation of Douglas Fir at High Temperatures: Bailey Tremper.

The Manufacture of Ethyl Alcohol from Wood Waste. III. Western Larch as a Raw Material: F. W. Kressmann.

The butt log of western larch is usually left in the woods because of the presence of shakes and also because of the weight of the log, which is heavier than water and, therefore, sinks, preventing rafting. An investigation of this material showed a sugar yield of 29.7 under the same conditions that would yield about 22 per cent. from white spruce. However, only 37.9 per cent. of the larch sugar was fermentable against from 60 to 65 per cent. of total sugar fermentable from spruce. Analysis of the larch by Mr. A. W. Schorger of this laboratory showed only 42½ per cent. of cellulose as compared with about 56 per cent. from spruce and also the presence of about 12 per cent. of galactan, which yielded galactose on hydrolysis, which, however, was not fermentable by the yeast used. Calculations show that the proportion of fermentable sugars to cellulose is about the same for larch as for spruce. If a yeast is found which will ferment the galactose as well as the dextrose within the time limits and other limitations, as prescribed by the Bureau of Internal Revenue, this material will afford a very good raw material for the production of ethyl alcohol.

The Production of Acetone from Pyroligneous Acid: Marc Darrin.

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

Floyd W. Robinson, Chairman

Glen F. Mason, Secretary

The Activity of Proteolytic Enzymes in Breadmaking: Arnold Wahl.

The Spontaneous Decomposition of Butter Fat: C. A. Browne.

The analytical constants are given for a number of butter fats exposed to the light and air before and after a period of 15 years. The results show that the fats have undergone an increase in the acid, saponification and volatile acid numbers and a decrease in the ether and iodine numbers. The mean molecular weight of the free volatile acids was 91.7 and of the combined volatile acids 105.4; the average mean molecular weight of the total volatile acids was 99.5, which agrees closely with that for normal butter fat. The total percentage of volatile acids had increased from 7.2 per cent. to 8.6 per cent. and the total percentage of insoluble acids had decreased from 87.6 per cent. to 79.7 per cent. The insoluble acids had an acetyl number of 36.4 corresponding to 20 per cent. of hydroxy-stearic acid and an ether number of 8.3 corresponding to 4.2 per cent. of stearo-lactone. A proximate analysis of the decomposed butter fat gave 63.50 per cent. neutral fat, 27.15 per cent. free insoluble acids, 3.90 per cent. free soluble acids, 5.42 per cent. undetermined. The iodine number of the free insoluble acids was 11.3 and of the combined insoluble acids 12.1. Experiments upon the change in weight which butter fats undergo with age showed that there was a 2 per cent. to 3 per cent. increase in weight in about one year, the period of greatest increase being about the tenth week. Very old butter fats lose in weight, owing to the escape of water, carbon dioxide, volatile acids and aldehyde decomposition products. The theories of the spontaneous decomposition of fats are discussed; the author believes that the observed facts are best explained by supposing an absorption of oxygen molecules from the air at the unsaturated bonds, one atom of active oxygen being liberated for each atom of oxygen absorbed. The disintegration of the glycerides, being proportional to the percentage of unsaturated acids, is attributed to the action of the active oxygen. Experiments are cited to prove that such atoms of active oxygen are formed.

The Analysis of Maple Products. V. Miscellaneous Observations on Maple Syrup Incidental to a Search for New Methods of detecting Adulteration: J. F. Snell.

(1) Silver nitrate added to maple syrup gives a white precipitate which darkens on standing. The precipitation of silver continues during a period of several hours. (2) Mercuric acetate added to maple syrup produces a light yellow precipitate. (3) Alcohol produces a precipitate containing most of the calcium and potassium. (4) A moderately successful attempt was made to combine the advantages of the Winton and Canadian lead subacetate methods. (5) The Canadian lead precipitates from six syrups showed a lead content of 66.95 to 69.62 per cent. Average 68.42. The precipitate from a composite of 542 syrups contained 69.41 per cent. of lead, while

that from another mixed syrup contained 70.11 per cent. (6) Titration of maple syrup with *N*/50 silver nitrate (*a*) directly, using electrical resistance measurements to detect the end point (b) after treatment with lead subacetate, or alumina cream, using potassium chromate as indicator yielded definite but not useful results. (7) Titration with uranyl acetate gave no useful results. (8) Titration with lead subacetate solutions using electrical resistance as indicator led to a useful method of testing the syrup for purity, which is described in the next paper of the series.

A Volumetric Lead Subacetate Test for Purity of Maple Syrup: J. F. SNELL, N. C. MACFARLANE AND G. J. VAN ZOEREN.

(1) The volumetric lead subacetate test consists in diluting the syrup to ten times its original volume and titrating with lead subacetate solution of sp. gr. 1.033, obtaining the end-point by measurements of electrical resistance. (2) The volumetric lead number is the abscissa of the point of intersection of two straight lines on the plot of volumes as abscissæ with resistance as ordinates. (3) Seventy genuine Quebec 1914 and 1915 syrups gave volumetric lead numbers ranging from 4.8 to 6.6—a range of 37.5 per cent. of the minimum as compared with 97 per cent. for the conductivity value. Twenty-eight of these syrups showed a range of 75 per cent. for the conductivity value and 339 per cent. for the Canadian lead number, while the range of volumetric lead number was the same as in the whole 70. (4) Seventeen out of 20 syrups containing 30 per cent. of sucrose syrup gave smooth curve plots. Eighteen out of 20 containing 40 per cent. sucrose syrup gave smooth curves and the remaining two gave intersections outside the limits for genuine syrups. Of 14 adulterated and non-maple syrups 10 gave smooth curve plots, 2 gave intersections outside the limits found in genuine syrups and in the remaining 2 (cane molasses) the electrical resistance remained constant.

The Electrical Conductivity Test for Purity of Maple Syrup. Corrections and Supplement to Paper I.: J. F. SNELL.

(1) A number of minor corrections to paper I., as published in the *Journal of Industrial and Engineering Chemistry*, are noted. (2) The directions are modified to suit a new type of electrode. (3) Experience with the test has shown that the limits of variation of the conductivity value in genuine syrups are wider than appeared when paper I. was published. However, these limits are still narrower than those of any of the older analytical values.

The Determination of Total Solids in Milk by Open-Air and Vacuum Methods: GEO. GRINDROD.

Results obtained by several different methods of drying are given and the methods compared as to accuracy. Moisture absorbed by milk residues was found to cause them to lose weight when further heated. Repeated weighing till minimum weight is reached, as usually practised, is liable to cause erroneous results on account of moisture absorbed during weighing. Repeated analyses of samples from the same lot of condensed milk over a period of one year show atmospheric pressure drying subject to error. Vacuum apparatus especially adapted to determination of total solids in milk is described. Results by this apparatus found more accurate than other methods.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

G. A. Hulett, Chairman

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Anodic Relations of Passive Iron: H. G. BYERS AND SETH C. LANGDON.

Electrolytic Endosmose: RUBY CLIFT AND GEORGE GLOCKLER.

The Stabilizing Influence of Hydrogen Sulfide on Colloidal Metallic Sulfide Solutions: S. W. YOUNG.

Equilibria Internary Systems containing Alcohols, Salts and Water: GEORGE BELL FRANKFORTER AND STERLING TEMPLE.

A study was made of the use of some salts to determine the per cent. of alcohols in mixtures of alcohol and water by means of the amount of salt which could be added without causing a separation into two layers. Curves were drawn and directions given for the use of the method. The following systems were investigated: Propyl Alcohol–Sodium Carbonate–Water, Isopropyl Alcohol–Potassium Fluoride–Water, Isopropyl Alcohol–Potassium Carbonate–Water, Allyl Alcohol–Potassium Fluoride–Water, Allyl Alcohol–Potassium Carbonate–Water, Allyl Alcohol–Sodium Carbonate–Water and Allyl Alcohol–Sodium Chloride–Water. This work together with the work of Frankforter and Frary indicates that potassium fluoride and potassium carbonate can be very successfully used for a quick method of determining the strength of solutions of ethyl, propyl, isopropyl and allyl alcohols. The evidence did not support the hypothesis that the salting out power of a salt could be predetermined from a knowledge of the ions in the solution, but showed that it was rather a function of the amount of water which the salt took up to form its hydrates, the

solubility of the salt and of its hydrates both in water and in alcohol and the ability of the alcohol to displace the water of combination.

Equilibria in Systems of Ketones, Water and Salts with a Method for the Determination of Methyl Alcohol in the Presence of Acetone: G. B. Frankforter and Lillian Cohen.

The Influence of Dissolved Substances upon the Velocity of Crystallization of Under-cooled Water: James H. Walton, Jr., and A. C. Brann.

The velocity of crystallization of under-cooled water has been measured at —9°, and the inhibiting effect of dissolved substances—such as acids, alkalies, salts, alcohols and some colloidal substances—determined. When possible tenth molecular solutions were used. It has been found that a rough proportionality exists between the number of atoms in the molecular and the inhibiting effect. The greater the number of atoms in a molecule of dissolved substance the slower the rate of crystallization.

The Partition Coefficients of Hydrogen Peroxide between Water and Certain Organic Solvents: James H. Walton, Jr., and H. A. Lewis.

Hydrogen peroxide is soluble in many organic solvents, such as phenol, aniline and certain esters. In general, any organic liquid that dissolves water will dissolve hydrogen peroxide. A determination of the partition coefficient in most of these solvents shows a normal molecular weight for the peroxide. In Quinoline the partition coefficient water: quinoline, is about 1: 3. This ratio changes with change of concentration of hydrogen peroxide, pointing to association of the molecule in the quinoline solution. The partition coefficient water: quinoline, has been studied at various temperatures.

The Preparation of Pure Iron and Iron Carbon Alloys: J. R. Cain, E. Schramm, and H. E. Cleaves.

It is shown that previous work on the iron-carbon diagram is unsatisfactory because of the great variation in the materials used. It was therefore thought necessary to produce a series of alloys of great purity to form the basis of a redetermination of the diagram at the Bureau of Standards. The general method pursued consisted in melting electrolytic iron with sugar carbon in magnesia crucibles. The electrolytic iron was prepared from ingot iron anodes in a chloride bath with or without the use of porous cups. The operation of melting the iron with carbon gave great trouble at first, because the ingots obtained were full of blow-holes and contained considerable quantities of impurities. The difficulties were overcome by melting in a vacuum furnace, and making crucibles of especially pure magnesia, made and calcined with great care at the Bureau of Standards. A satisfactory procedure was finally worked out and a series of alloys prepared of the composition Fe + C = 99.96 per cent.

The Oxides of Iron. I. Solid Solution in the System Fe_2O_3—Fe_3O_4: Robert B. Sosman and J. C. Hostetter.

This investigation of the chemical relationships of the iron oxides has been undertaken as a basis for the study of the iron-bearing silicates at high temperatures. Measurements of the dissociation pressure of the iron oxides were made in a vacuum furnace with a heating tube of platinum-rhodium. A study of the conditions of equilibrium shows that reproducible oxygen pressures can be obtained at a given temperature. Equilibrium is attained in a few minutes at high temperatures, although certain disturbing reactions go on slowly. One of these by-reactions is the reduction of the oxide by platinum, yielding oxygen and an iron-platinum alloy. Another is a slow disappearance of oxygen, which has not been satisfactorily explained. Ferric oxides from various sources yield practically identical pressures. The same pressures are also attained on both rising and falling temperatures. The oxidation of magnetite gives pressures which are a little higher than those produced by dissociation of Fe_2O_3. The pressure-composition isotherm for the system Fe_2O_3—Fe_3O_4 at 1,200° indicates a continuous solid solution series from Fe_2O_3 over to a point very near Fe_3O_4, if not over the entire range to Fe_3O_4. The opacity of the products prevents an optical demonstration of the existence of solid solution in products with more than 18 per cent. FeO, but its existence can be shown optically in products which are more ferric than this. The pressure-composition isotherm at 1,100° confirms that at 1,200°. The major portion of the oxygen pressure curve of the system at 1,200° lies between the limits 4 mm. and 1.5 mm. The pressure drops rapidly near Fe_3O_4, and rises rapidly near Fe_2O_3. Since the dissociation of Fe_2O_3 results in the formation of a solid solution, the pressure of oxygen and the composition of the solid phase depend upon the relation of the weight of the charge to the volume of the space into which the oxygen dissociates. This fact accounts for the variety and un-

certainty of results heretofore obtained in experiments on the dissociation pressure of Fe_2O_3.

The Water Correction in Conductivity Determinations: JAMES KENDALL.

Conductivity water, however carefully prepared, can not be kept for more than a short period in contact with air without its specific conductivity rising to about 0.9×10^{-6} reciprocal ohms (at 25° C.). This value represents also the specific conductivity of pure water saturated with CO_2 under the ordinary atmospheric partial pressures (3.69 parts in 10,000). It is therefore possible to obtain accurate conductivity values for very dilute solutions of any electrolyte by applying a correction for carbonic acid. This has been done for strong electrolytes (Arrhenius), transition electrolytes (Kendall), and weak electrolytes (Walker and Kendall). The results obtained indicate conclusively the accuracy of the corrections so applied.

Conductance Data and Empirical Equations: STUART J. BATES.

The application to experimental data of empirical equations or of the similar but less sensitive method of plotting the results, is of value chiefly as a means of interpolation and of judging the accuracy of data. However, in the latter case great caution must be employed. This is illustrated by the fact that as a result of the application of the Kraus equation to the conductance data for KCl, the data below 0.001 N were rejected as inaccurate. It is found, however, by the application of the equation

$$\log \frac{C_i^2}{C_u} = K + TX^m,$$

where $X = C_i$, C_u or C, to these data, that they are consistent. The data for KCl between 1.0 N and 0.0001 N agree with this equation with an average deviation of but 0.03 per cent. when $X = C_i$ or C_u and of 0.07 per cent. when $X = C$. The above equation is applicable to other aqueous solutions and to non-aqueous solutions. It is apparently as generally applicable as that of Kraus. However, in the case of salts such as KNO_3 which give a minimum value for n (the exponent in Storch's equation), neither the equation of Kraus nor that given above is capable of representing the data throughout the entire concentration range.

A Quantitative Measure of the Deviation from the Law of Mass Action: STUART J. BATES.

The strict obedience of an electrolyte to the law of mass action may be readily tested by observing the constancy of the equilibrium expression C_i^n/C_u. However, this does not afford a quantitative means of judging the magnitude of the deviations at different concentrations of two or more electrolytes. For example, which deviates the more, dichloracetic acid at 0.1 N or KCl at 0.001 N? The equilibrium expression for a strong electrolyte corresponding to any concentration may be calculated, but there is nothing with which to compare it, for in this case the uncertainty in the "ionization constant at infinite dilution" which is a true constant in the case of weak electrolytes, is often as great as 1,000 per cent. However, if the law of mass action is obeyed by a diionic electrolyte at a certain concentration, then the exponent n in Storch's equation $C^n/C_u = K$, has the definite and theoretical value 2. By comparing the value which n does have at a given concentration with this value (2), a quantitative measure of the deviation is given. Let $d = (2 - n)/n$, then if $d = 0$ the mass law is obeyed. The greater d is, the greater the deviation; d may be either positive or negative. Since in general n changes with the concentration, d changes with the concentration, becoming smaller with decreasing concentration. The undissociated molecules are in general largely responsible for the deviation from the law of mass action. Since their behavior may be readily expressed in terms of osmotic pressure, d has been defined so that it is an approximate measure of the deviation of these molecules from van't Hoff's law.

Ion Concentration and the Law of Mass Action: STUART J. BATES.

The deviation of solutions of strong electrolytes from the law of mass action is usually considered to be due to the presence of the charged ions in the solutions. This view has an *a priori* possibility and is considered by many to be supported by two facts. The first is that the conductance of solutions containing two salts may be readily calculated upon the isohydric principle. Bray and Hunt have pointed out, however, that the conductance may be calculated upon the basis of the total concentration also. The second is that the equilibrium expressions of strong electrolytes may be readily expressed as functions of the total ion concentration, as for example, by the equations of Storch and of Kraus. But the expression may be equally well represented as a function of the total concentration or of the concentration of the undissociated molecules. (See preceding abstracts.) Direct proof that the ion concentration does not control the thermodynamic environment of the so-

lution, that is, that it does not materially influence the deviation from the law of mass action, is afforded by a comparison of the magnitude of the deviation at various ion concentrations for different electrolytes. Thus at the ion concentration 0.001 *N*, *d* for KCl equals 0.29, for dichloracetic *d* is less than 0.003 and for acetic acid it has a small negative value. At the ion concentration 0.05 *N*, the values for the first two electrolytes are 0.40 and 0.06, respectively. Evidently there is no parallelism between ion concentration and the magnitude of the deviation from the law of mass action. The former does not control the latter. The osmotic pressure or activity of the undissociated molecules depends largely upon their type. They are more abnormal the stronger the electrolyte.

The Calorimetric Determination of Ferrous and Ferric Iron: O. L. Barnebey.

Differential Iodimetry. I. The Titration of Periodates, Iodates, Bromates and Chlorates in the Presence of Each Other and in the Presence of Perchlorates: O. L. Barnebey.

Molecular Weights of Gases by an Evaporation Method: H. L. Trumbull.

That liquids evaporate into different gases at different rates was first pointed out by Stefan. Winckelmann, and Guglielmo extended the work of Stefan, to include many liquids, and a general agreement between all their results was noted, viz.: that evaporation is most rapid into hydrogen and correspondingly less rapid into heavier gases. The methods employed by the earlier investigators were not all that could be desired, being at fault in the matters of temperature control, elimination of wind currents, and the employment of a height loss, rather than a weight loss method.

The object of this investigation was to find a simple and accurate method for the measurement of rates of evaporation of water into different gases, with a view to the relations between the rates and densities of the gases used. These experiments were conducted in a perfectly dry atmosphere, free from air currents, at a constant temperature of $25°.07 \pm 0°.01$, and by a weight loss method. A comparison of the evaporation constants obtained in this experiment leads to the following results. The predicted values of the relative diffusion rates on the basis of Graham's law are hydrogen to air, 3.79, hydrogen to CO_2, 4.67, air to CO_2, 1.24. The means of the corresponding rates by this evaporation method are 3.37, 4.68, and 1.393. Various applications are cited.

Production of Potassium Chlorate from Kelp: H. L. Trumbull and H. C. Howard.

Electrolysis of a solution obtained by pressing and lixiviating the kelp produces chlorates with a current efficiency of 50 per cent. and an energy expenditure of 7K.W.H. per pound of chlorate. No purification of the raw material is required. Because of the great difference in solubility of the sodium and the potassium chlorates the latter is easily obtained in a pure state.

Division of Industrial Chemists and Chemical Engineers

Geo. P. Adamson, Chairman

S. H. Salisbury, Jr., Secretary

Additional papers not read in symposiums.

Refining Vegetable Oils: Chas. Baskerville.

The Relation of Water Power to Chemical Industry: Henry J. Pierce.

"Viscosimeters": R. F. MacMichael.

The Function of Cooking Fossil Resins in Varnish Manufacture: W. L. Jeffries and Chas. H. Herty.

A Test of a Surface Combustion Furnace: E. Schramm and J. R. Cain.

In view of the fact that the surface combustion process appeared to offer many advantages for high-temperature laboratory furnaces, it was decided to submit a crucible furnace of this type to a thorough test. For the purpose, the furnace was equipped with meters on the gas and air lines and with a chimney to permit the collection of flue gas samples. In several runs the mixture proportions were maintained constant, while varying the rate of gas consumption. Temperatures were read by a Hollborn-Kurlbaum optical pyrometer. The highest temperature reached was 1675° C., at which point the alundum muffle failed. The test established that complete combustion could be attained without excess air, that the best air: gas ratio was 5.5, and that a 20-per-cent. excess of air caused a lowering of furnace temperature of 100°.

Biological Chemistry Division

Carl L. Alsberg, Chairman

I. K. Phelps, Secretary

Mutual Action of Similarly Charged Colloids: W. D. Bancroft.

Adsorption of Colloids by Liquids: W. D. Bancroft.

Formation of Surface Films: W. D. Bancroft.

A Search for Hydrocyanic Acid in the Caprifoliaceæ: C. L. Alsberg.

A number of American species of the Caprifoliaceæ were tested for hydrocyanic acid, because those reported from other countries showed the presence of hydrocyanic acid. Those tested showed none, either on hydrolysis with acid alone or with emulsion also present.

The Reaction of the Pancreas: J. H. LONG AND F. FENGER.

The pancreatic juice of man and the domestic animals, as collected by a fistula, is known to have a rather marked alkaline reaction. No attention has been paid to the reaction of the press juice of the organ itself. This may be separated by pressure from the minced gland, but very perfectly by aid of one of the powerful laboratory centrifuges now in use. In the experiments carried out by the authors the centrifuge tubes were charged with about 75 grams of the minced organ, each, and given a speed of 3,000 revolutions per minute through 45 minutes. The clear liquid separated, the real pancreatic juice, had a distinct acid reaction in the cases of the beef, hog and sheep pancreases, and nearly constant in degree. It was found to lie between $C = 25 \times 10^{-7}$ and 30×10^{-7}. The reaction may be found to be as characteristic as that of the blood and is doubtless related to it. In the physiological activity of the organ an acid fraction seems to be retained, while an alkaline fraction is thrown to the duodenum. A rearrangement of the phosphate and carbonate groups of the blood would account for both reactions. In this centrifugal separation, besides the liquid, a lower layer of matter largely protein is obtained and an upper layer of fat and protein. The fresh minced gland, also, shows the acid reaction.

On the Digestive Activity and Composition of Separate Fractions of the Pancreas: J. H. LONG, MARY HULL AND H. V. ATKINSON.

As shown in the preceding abstract, the minced pancreas may be readily separated into three fractions by rotation in a powerful centrifuge. The authors have found the relative volumes of these fractions somewhat variable, depending on the speed and duration of rotation. The lower layer may make up fifty per cent., or more, of the whole, and is largely protein. It exhibits both amylolytic and tryptolytic activity. The middle layer is liquid and usually makes twenty to twenty-five per cent. of the contents of the centrifuge tube. The starch-converting power of this liquid is sometimes very strong, especially in the case of the hog pancreas, where one part of it has been found to convert over 150 parts of starch to the colorless end-point in ten minutes. Trypsin is also present, and no activator is required to bring out its power. The top layer contains much fat and some protein and is deficient in ferment activity. The fat is rich in phosphorus, pointing to the presence of lipoid bodies of the lecithin type. The freezing-point of the liquid layer is apparently a constant for the product from each animal, provided the maximum of liquid is obtained. For the beef product the value was found to be about —1.12 and for the hog —1.62. The investigations are being continued.

Kelp: F. K. CAMERON.

The Inadequacy of Schultz's Valency Rule: W. D. BANCROFT.

The Evolution of the Yeast Type especially Adaptable for Bread-making: A. WAHL.

A Theory regarding Protoplasmic Structure, based on the Study of Emulsion Equilibrium: G. H. A. CLOWES.

Alleged Abnormal Adsorption of Filter Paper: W. D. BANCROFT.

Adsorption of Acids by Cellulose: W. D. BANCROFT.

Oxycellulose: W. D. BANCROFT.

Boron—Its Absorption and Distribution in Plants and Its Effect on Growth: F. C. COOK.

Boron was applied to manure as a larvicide for the fly maggot, either as borax or calcined colemanite. The effect of the boron-treated manure on plant growth was studied at Arlington, Virginia, Dallas, Texas, New Orleans, Louisiana, and Orlando, Florida, and various plants and soil samples were analyzed for boron. Boron was absorbed by the plants from the calcined colemanite plats in the same amounts as from the borax plats. Lime added to the manure with the borax had no definite action in preventing the absorption of boron.

Potatoes, string beans, soy beans and cow peas showed a more equal distribution of the boron among the roots, tops and fruit than was the case with the wheat, beets, tomatoes, radishes and lettuce plants analyzed. In some cases very little boron was found in the roots or fruit, while a considerable amount was found in the rest of the plant. All control plants contained at least a trace of boron. Some control samples of soil contained boron soluble in weak hydrochloric acid, while several of the boron-treated plats several months after boron was added showed none soluble in weak hydrochloric acid in the upper six inches of soil. If sufficient boron was added to the soil a yellowing of the leaves took place, but this does not neces-

sarily indicate that the yield will be affected. The leguminous plants were more sensitive to boron than the other plants tested. Variations in soil, climate and the resistance of different varieties make it impossible to give a figure for the amount of boron which all plants can stand with impunity.

Boron, Its Absorption and Distribution in Plants and Its Effect on Growth: F. C. Cook.

A Study of the Calcium and Magnesium Metabolism in a Case of Chronic Gout: Jacob Rosenbloom.

Metabolism Studies in a Case of Bronchial Asthma: Jacob Rosenbloom.

Note on Semipermeable Membranes: W. D. Bancroft.

Dilute Solutions of Gelatine: W. D. Bancroft.

Nephelometric Estimation of Phosphorus: Philip Adolph Kober and Grete Egerer.

(1) The reagent of Pouget and Chouchak has been modified so as to be: (*a*) stable, (*b*) colorless, (*c*) quantitatively and (*d*) nephelometrically applicable. (2) It is shown that 0.005 milligram of phosphorus in 10 c.c. of solution, or some part of phosphorus in two million parts of water is easily determined quantitatively with the nephelometer.

Spectrographic Study of Amino Acids and Polypeptides: Philip Adolph Kober, with the assistance of Walther Eberlein.

(1) The absorption of aliphatic amino acids, in acid or alkaline solution, is only general, in the extreme ultra-violet. (2) The aromatic amino acids show absorption bands, which may be useful in detecting their presence in peptide chains. (3) The presence of an excess of alkali with these substances seems to increase the amount of absorption and tends to shift it towards the red end of the spectrum. (4) The absorption of di- and tri-peptides in acid or alkaline solution showed no special absorption, it being similar to that of the free amino acids. (5) The lack of special absorption of the peptides in alkaline solution; and other points which were discussed, show that the keto-enol tautomerism in peptide linkings, as suggested by Dakin and Dudley, in explanation of the "racemization" of proteins, is doubtful and unsupported.

Production of Citric Acid by Black Aspergillus: James N. Currie.

The acidity of young cultures of black *Aspergillus* (*A. niger*) was found to be greater in many cases than could be accounted for by the oxalate radical present. A study of this problem revealed the fact that citric acid to the amount of 0.3 to 0.4 gram per 100 c.c. of media was present. The citric acid seems to be a transitory product which appears almost as soon as the mold begins to develop, reaches a maximum in 3 to 4 days, then declines and in most cases disappears within a week.

Production of Oxalic Acid by Aspergillus Ficuums: James N. Currie.

The literature of fungi records *Aspergillus niger* as the oxalic acid ferment par excellence and states that this mold will produce one per cent. of free oxalic acid on sugar media. A culture of *Aspergillus ficuum*, Schiemann, which has come under our observation produces on cane sugar media under favorable conditions 2.7 to 3.0 per cent. of free oxalic acid and in the presence of $CaCo_3$ give a yield of 80 per cent.

An Oxalic Acid Producing Penicillium: James N. Currie and Charles Thom.

A green penicillium common on moldy corn and corn meal was observed to produce large amounts of oxalic acid. This mold resembles *P. italicum* of Wehmer in morphology, but differs so widely from that species in appearance and habits that we propose the name *P. oxalicum*. On a 5 per cent. sugar medium it produces an acidity of about 0.8 per cent., calculated to $(COOH)_2$, $2H_2O$, in one week, and in the presence of $CaCO_3$ converts 40 per cent. of the sugar to oxalic acid. This is much the most active oxalic-acid producer ever observed among the penicillium.

Quantitative Changes in the Growth of the Human Brain: E. A. Dorsey and C. G. MacArthur.

The per cent. of solids increases with age to maturity. The cerebrosides and sulfatids are not found in fetus or brains up to a year old. From that time on they increase gradually with age to maturity. The proteins and phosphatids become larger in percentage amounts from three-month fetus to nineteen-year brain. From that age on most of the constituents are nearly constant.

Respiration of Nervous Tissue: O. C. Jones and C. G. MacArthur.

A comparison of the various parts of the nervous system showed that the cerebrum and cerebellum respire fastest. Then, mid-brain, corpus callosum, medulla in the order named. The spinal cord takes up about half as much oxygen and gives off about half as much carbon dioxide as the cerebrum. The sciatic nerve, however, respires but half as fast as the spinal cord. Of the different animals, in general, the older and larger respire more slowly, per gram of tissue, than the younger and smaller. This investigation was carried out

with a modification of the Mathews-Bunzel oxidation apparatus on very fresh tissue.

Nitrogenous Products from Brain Lecithin: J. DARRAH AND C. G. MACARTHUR.

There is about 0.2 per cent. nitrogen in brain lecithin in an unknown form. This remains in the fatty acid residue after hydrolysis of the lecithin. About 0.8 per cent. nitrogen is present as chlorine. This was confirmed in the usual way as the platinum compound. The other 0.8 per cent. of the nitrogen was identified as amino ethyl alcohol both by the gold salt and by the picrolonate derivative.

Some Physico-Chemical Properties of Several Brain Lipoids: G. NIEDERMAN AND C. G. MACARTHUR.

Respiration of Nerve Tissue: O. C. JONES AND C. G. MACARTHUR.

Some Effects of Large Applications of Certain Commercial Fertilizers: GEORGE D. BEAL AND FRED WEAVER MUNCIE.

In connection with the study of fertilizers for greenhouse crops, the author has investigated the effects of excessive applications of certain commercial fertilizers upon carnations. The fertilizers chosen for this purpose were ammonium sulfate, dried blood, commercial acid phosphate, disodium phosphate and potassium sulfate. It was found that the ease and rapidity with which overfeeding effects appeared depended in a general way upon the solubility of the fertilizer in water, and three classes were distinguished: (1) those fertilizers quite soluble and producing immediate injury when applied in large quantities; (2) those fairly soluble and producing delayed injury, and (3) those difficultly soluble and producing no injury when applied in any quantities. Ash and mineral determinations showed the increased intake of the fertilizing salts when large quantities were applied. The total nitrogen content of the plants could be increased nearly threefold when ammonium sulfate was applied to the soil. Serious injury followed the use of large quantities of it, although the plants acquired a certain tolerance when the salt was applied over a long period in small quantities. Free ammonia (as ammonium salts) was found in plants so fed. Lime decreased the intake of sulfate and phosphate, but increased the injury from ammonium sulfate. Osmotic pressure determinations on the sap from shoots (expressed after freezing) showed that with any single fertilizer the increased intake of the salt, and after injury became apparent, the greater degree of injury was correlated with a higher osmotic pressure value. The value at which injury became noticeable was different for the different fertilizers, being lowest for ammonium sulfate and highest for potassium sulfate. Total solids determinations on the sap from plants treated with the latter salt were abnormally high. A study of the sugar content of the sap by polarimetric and gravimetric methods showed a larger percentage of sugars in this sap than in that from plants normally fed. This increase was shown to be due to a larger amount of maltose. Starch determinations made on the foliage showed a lower content of starch corresponding with the higher maltose value. Under greenhouse conditions applications of ammonium sulfate caused an increase in the total acidity of the sap expressed from the shoots. Potassium sulfate caused no change. Sodium phosphate (di) although slightly alkaline to phenolphthalein itself caused an increased total acidity in the sap. This was shown to be due to increased amounts of dihydrogen phosphate in the sap, and the intake of the phosphate from this monohydrogen salt in form of the dihydrogen phosphate to be true in water culture as well as in soil.

Improved Methods for the Separation of the Higher Saturated Fatty Acids and the Properties of Alfalfa Seed Oil: C. A. JACOBSON.

DIVISION OF PHARMACEUTICAL CHEMISTRY

F. R. Eldred, Chairman

A. P. Sy, Secretary

The Alkaloidal Content of Hyoscyamus grown in Minnesota: E. L. NEWCOMB.

N. and H. advise treating biennial henbane seed with conc. H_2SO_4 for two and one half minutes in order to secure early and uniform germination. Untreated seed give very variable germination results.

The observation of two species of biennial *Hyoscyamus niger* which possess the semi-latent capacity of growing as annuals is reported. The basal leaves of the biennial *H. niger* lose about 9 per cent. of moisture upon drying. The lamina yield from 14.2 to 14.8 per cent. of ash and 0.0896 per cent. of total alkaloids. The petioles of the basal leaves lose 91.6 per cent. of moisture upon drying, yield from 18.9 to 18.8 per cent. of ash and from 0.0896 to 0.1012 per cent. of total alkaloid. The flowering tops of *H. niger* annual lose 85.06 per cent. of moisture upon drying, yield from 11.41 to 11.66 per cent. of ash and from 0.1301 to 0.1561 per cent. of total alkaloid. The flowering tops of *H. niger* annual var. *pallidus* lose 84.8 per cent. of moisture upon drying, yield

from 11.99 to 12.33 per cent. of ash and from 0.1243 to 0.1301 per cent. of total alkaloid. All samples reported upon were prepared from plants cultivated in the Medicinal Plant Garden, College of Pharmacy, University of Minnesota.

Some Notes on Sandalwood, Its Assay, Yield of Oil, and Changes in the Oil during Distillation: C. H. Briggs.

Iso-pulegol Phosphonic Acid: Francis D. Dodge.

The writer has made a further examination of the crystalline acid, containing phosphorus, resulting from the reaction of phosphoric anhydride on citronellal.

The compound is very stable, and yields a series of well-crystallized salts. By dry distillation of the sodium salt, a volatile alcohol was obtained, apparently identical with the iso-pulegol of Tiemann, a cyclic isomer of citronellal. The acid is then most probably a phosphonic acid of iso-pulegol, and hence a very characteristic derivative of citronellal.

Attempts to demonstrate the presence of citronellal in oil of lemon, by means of this reaction, were unsuccessful.

Note on the Use of the White Mouse as a Test Animal for Determining the Toxic Coefficients of Various Drugs: J. H. Beal, C. G. MacArthur and E. A. Doisy.

Color Standards and Colorimetric Assays: H. V. Arny.

Electrolytic Determination of Mercury in Mercury Oleate: B. L. Murray.

Electrolytic Determination of Bismuth in Bismuth Betanaphthol: B. L. Murray.

Electrolytic Determination of Mercury in Mercury Salicylates: B. L. Murray.

A rapid and convenient method of determining mercury in mercury salicylates is herewith presented. It consists in a new application of the already well and favorably known electrolytic deposition of mercury. The method here given as used on salicylates of mercury has been in use about two years and has proved reliable.

About 0.3 gram is weighed into the mercury cathode dish and dissolved in 10 c.c. of sodium sulphide solution (sp. gr. about 1.18). To this solution are added 20 c.c. of 10 per cent. potassium hydroxide solution. The mixture is now electrolyzed, using a current of 1 ampere and 7 volts until the mercury is completely deposited, usually about one half hour being required. The anode should rotate about 500 revolutions per minute. After the deposition the electrolyte is decanted, the mercury is washed with water until free from alkalinity, then with alcohol, finally with ether, and then weighed.

Hardness, Weight and Thickness of Medicinal Tablets: A. D. Thorburn.

The Rate of Evaporation of Ether in Oil-Ether Anesthesia: Chas. Baskerville.

The Identification of the Emodin Containing Drugs: Geo. D. Beal and Ruth E. Okey.

Some New Laboratory Methods: Albert Schneider.

Division of Organic Chemistry

F. B. Allan, Chairman

C. G. Derick, Vice-chairman and Secretary

The Chemistry of Enzymic Action: J. U. Nef.

The First of the Enzymes and Its Evolutionary Significance: R. G. Eccles.

(1) The prototrophic bacteria as the most primitive known organisms on the earth.[2] Metabolism of *Nitroso-coccus* of South America, and *Nitoso-monas* of Europe (Fischer, p. 104). (3) The first known exothermic reaction among the elements. Nitrogen as an acid and base forming element (HNO_3, N, NH_3). (4) Nitric oxide in the metabolism of nitrite bacteria. A substitute for sunlight. (5) Oxidases as peroxides. Autoxidation through iron, phosphorus and manganese. (6) Hydrolysis as related to oxidases. The too often overlooked difference between organic and inorganic hydrolysis and hydrosynthesis. The union of an inorganic acid and base and the union of amino acids very significantly *unlike*. As *generally interpreted* the $\overset{+}{H}$ and $\overset{-}{HO}$ ions of the two cases are reversed from one another. (7) Nucleic acid as probably related to enzyme action. (8) The co-enzymes and specificity.

A New Form of Absorption Bottle for Use with either Calcium Chloride or Soda Lime in Organic Combustion: H. L. Fischer.

Spectrophotometric Study of Copper Complexes and Biuret Reaction: P. A. Kober and A. B. Haw.

The absorption spectra of the copper complexes of amino acids, peptides and proteins were studied quantitatively, by means of a Hilger sector photometer and a spectroscope.

The results—the nature and amount of absorption—are in harmony with the theory of biuret reaction of Kober and Segiura.

[2] Brit. Encyclop., New Edition, Vol. 3, p. 165; Lafar's "Tech. Mycol.," Vol. I., p. 380; Fischer's "Structure and Functions of Bacteria," p. 51.

The Constitution of the Three Nitro-α-carbopyrrolic Acids: W. J. HALE.

The Oxidation of Ethyl Alcohol with Alkaline Potassium Permanganate: W. L. EVANS AND J. E. DAY.

The Oxidation of Certain Lactates with Potassium Permanganate: W. L. EVANS, P. A. DAVIS AND P. COTTRINGER.

Condensation Products of Menthane formed by the Action of Aluminum Chloride: GEO. B. FRANKFORTER AND A. L. NEWMAN.

In view of the fact that aluminum chloride has been found to act as a condensation agent on the various hydrocarbons in the presence of oxygen compounds as aldehydes and ketones, it was tried on menthane, first in the presence of hydrocarbons, and later it was tried on menthane alone. In the former case benzene was used with menthane. A substance was formed which did not contain oxygen. Analysis indicated that it was a tetranuclear compound containing two molecules of menthane and two benzene radicals. A bromine derivative was prepared. A condensation product was made from menthane alone. Analysis indicated that it was likewise a tetranuclear substance containing four menthane radicles. Bromine compounds were also prepared. Nothing as yet has been learned of the molecular structure.

The Polymers of Pinene: G. B. AND C. J. FRANKFORTER.

Pinene tends to form complex resinous substances when treated with any of the halogen elements, as chlorine, bromine or iodine in addition to the formation of hydric salts. Not only do the elements themselves react with pinene, but also certain of their salts. Thus chlorine or aluminium chloride added cautiously to pinene forms resinous substances in addition to the hydrochloride and tarry matter. The resinous matter thus formed was found to be a complex substance. Two definite substances have been isolated and carefully studied, while a third doubtless exists. Analysis of the two which have been studied indicate the formula $(C_{10}H_{16})_2$ and $(C_{10}H_{16})_4$.

The Electron Conception of Valence. A Laboratory Search for Electromers: OLIVER KAMM.

The electron conception of valence as advocated by Falk, Nelson and others predicts three isomers in many cases where the theory of cis-trans isomerism demands only one or two. An extensive search was therefore made in order to isolate some of these missing isomers. It has, however, been possible to explain all of the results obtained on the basis of the atomic linking theory without using the electronic formulæ for the double union.

The Rearrangement of (N) Alkyl Anilines: C. G. DERICK AND J. W. HOWARD.

The action of heat upon methyl aniline was studied. No change was observed up to 500°. Similar results were obtained with dimethyl aniline.

The action of heat upon the methyl aniline hydrochloride has been thoroughly studied. Under temperature of 250° no shifting of the methyl group from the side chain nitrogen atom to the ring carbon atom was found. On the other hand, the percentages of the primary, secondary and tertiary amines was found to be constant within the temperature limits 200°–250°, the times of heating two to forty-eight hours, and the volume of the bomb tubes. No quaternary compounds were detected. The primary, secondary and Tertiary amines were proven to be aniline, monomethyl aniline and dimethyl aniline, respectively. At 300° the reaction is very different. The methyl radical shifts from the nitrogen atom to the carbon atom of the ring.

The Synthesis of 1-Phen-3-Phenoxy-Propane by the Grignard Reaction: C. G. DERICK AND L. O. POTTERF.

For the preparation of the 1-phen-3-phenoxy-propane, phenyl magnesium bromide was prepared in the usual manner. The solvent ether was evaporated off on a water bath. The residue was dissolved in one and one half moles of phenetol and one mole of the 1-bromo-3-phenoxy-propane added. The solution was now heated slowly to the boiling-point under an air-condenser, when the last traces of ether were slowly driven off. This heating requires about an hour and is followed by three hours refluxing. The yield of the 1-phen-3-phenoxy-propane was 47 per cent., while if a few drops of dimethyl aniline were added the yield was increased to 61 per cent.

The Isomeric Tetracetates of Xylose and Observations regarding the Acetates of Melibiose, Trehalose and Sucrose: C. S. HUDSON AND J. M. JOHNSON.

The Preparation of Melibiose: C. S. HUDSON AND T. S. HARDING.

A Second Crystalline d-Fructose Pentacetate (α-d-Fructose Pentacetate): C. S. HUDSON AND D. H. BRAUNS.

Bromoacetylxylose and Beta Triacetylmethylxyloside: J. K. DALE.

An Undissociated Organic Acid in the Rôle of a Catalytic Agent: H. C. BIDDLE.

In the inversion of sugar and in the hydrolysis of esters in the presence of acids, the speed of the reaction is a direct function of the concentration of the hydrogen ions. In the conversion of cinchona alkaloids into their toxins, however, we are dealing with a catalysis in which the hydrogen ion acts as an inhibiting agent and the positive catalyst is the undissociated molecule of an organic acid.

The Isomerism of 1, 4, 5, 6, Tetrahydroxynaphthalene: A. S. Wheeler and V. C. Edwards.

Naphtazarin on reduction with stannous chloride and hydrochloric acid yields 1, 4, 5, 6, tetrahydroxynaphthalene, yellow, melting at 154°. It dissolves in alcohol, but deposits deep red crystals, also melting at 154°, which possess the same empirical formula and do not even differ in structure so far as the experiments of Zincke and Schmidt and ourselves indicate. We find, however, that the yellow compound, always considered a phenol, is also a ketone and must be included among the keto-enol compounds. We obtained excellent yields of ketone derivatives with semicarbazine, phenylsemicarbazine, and four other similar reagents. No oxime could be prepared on account of the sensitiveness of this phenol to basic reagents. According to whether we used one or two molecules of phenylsemicarbazine, we get a mono- or a diphenylsemicarbazone. Acetylation gives a high yield of a tetracetyl derivative. The isomers themselves we have been unable to separate.

The Bromination of 1, 4, 5, 6, Tetrahydroxynaphthalene: A. S. Wheeler and V. C. Edwards.

This phenol is readily brominated, best in glacial acetic acid solution, a dibromdihydroxyquinone being formed. If the bromination is carried out in hot acetic acid, the product contains two less H atoms. These products are very slowly acetylated with acetyl chloride and this made the starting-point of two series of derivatives whose character can not be indicated in a short abstract. Naphtazarine was also brominated and yielded a series of derivatives which assisted in determining the structure of members of the above series.

Simple and Mixed Alkyl Phosphates: W. A. Drushel.

1. The alkyl phosphates are very stable at room temperature in $N/10$ HCl, but are rapidly saponified by barium hydroxide.

2. All alkyl groups are hydrolyzable, the first more easily than the second and third.

3. In mixed alkyl phosphates one alkyl group is not hydrolyzed to the exclusion of the other, contrary to Lossen and Köhler's theory.

4. These esters are distillable in vacuo without decomposition.

On the Preparation and Properties of Hydracrylic Esters: W. A. Drushel and W. H. T. Holden.

Hydracrylic acid is obtained from glycerine through B-iodopropionic acid by the removal of hydriodic acid from the latter by silver oxide. It is easily esterified with common alcohols in the absence of mineral acids by using anhydrous copper sulphate. The yields of esters are from 80 per cent. to 90 per cent.

The hydracrylic esters are all colorless, with a faint but characteristic odor, mostly readily soluble in water, all below isoamyl hydracryate are heavier than water and all boil with decomposition at atmospheric pressure but are distillable under diminished pressure without decomposition.

On the Synthesis of Glycocoll and Diethyl Carbonate: W. A. Drushel and D. R. Knapp.

A modification of the method of Kraut for the preparation of glycocoll. The yield is the same as that obtained by Kraut (55 per cent.).

Nef's method for the preparation of diethyl carbonate is modified. Diethyl carbonate boils at 127°. The specific gravity at 25° is 0.968 and the saponification equivalent is 59.

Further Studies upon the Resene of Pinus Heteropylla: Chas. H. Herty and V. A. Coulter.

The Occurrence of Inosite Triphosphoric Acid in Cottonseed Meal: J. B. Rather.

An inosite phosphoric acid corresponding in composition to inosite triphosphoric acid, $C_6H_6(OH)_3(H_2PO_4)_3$, has been separated from cottonseed meal by means of its crystallin strychnin salt. This confirms the previous work of the author on the composition of the acid in so far as it indicates that cottonseed meal contains an inosite-phosphoric acid much richer in carbon and poorer in phosphorus than the so-called phytic acid $C_2H_8P_2O_9$. These results are not in accord with the view that the principal inosite phosphoric acid of cottonseed meal is inosite hexaphosphoric acid $C_6H_6(H_2PO_4)_6$, although it is possible that the present acid is a hydrolytic product of that substance.

Baly's Theory of Chemical Reactions: W. M. Dehn.

Study of the Common Bean: W. M. Dehn.

A Case of Steric Hindrance in Enzymes: W. M. Dehn.

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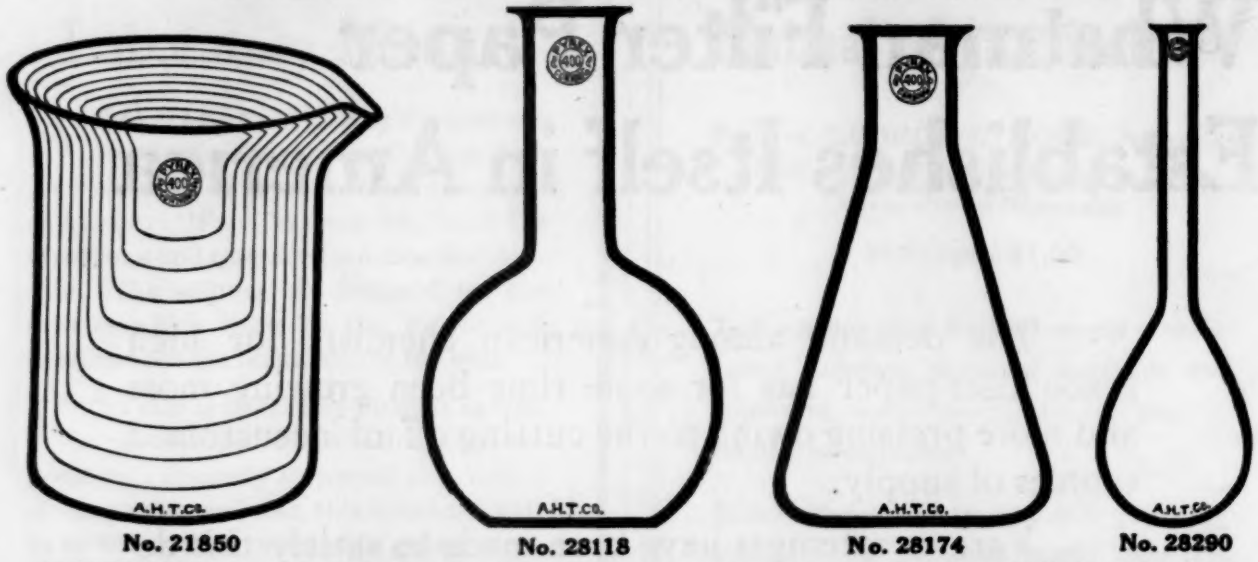

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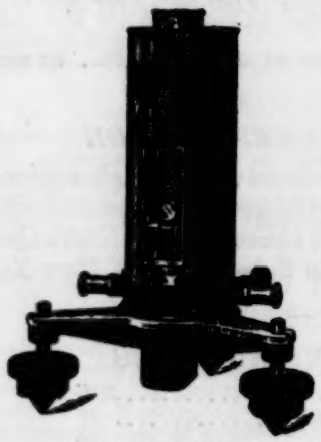

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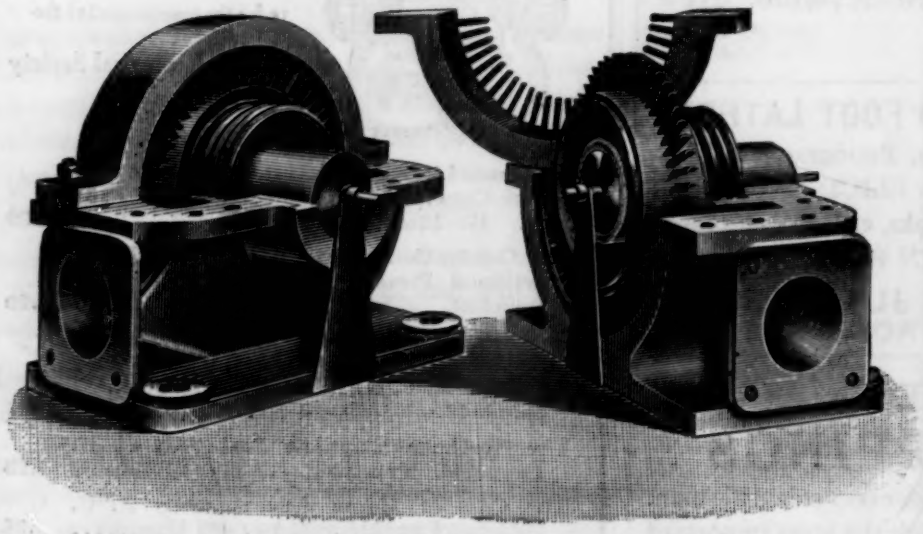

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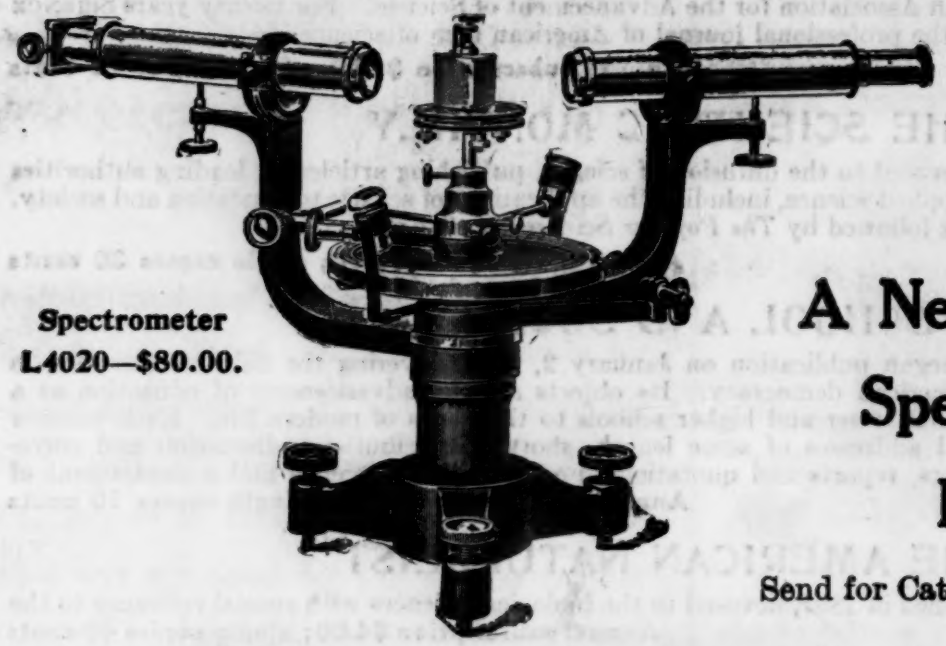

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